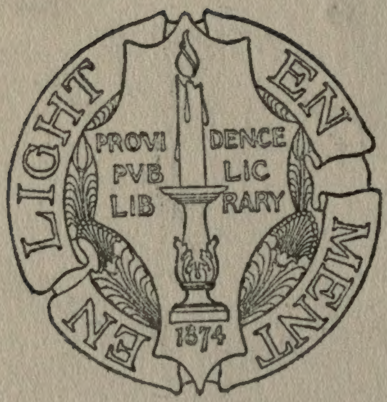

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OFFICE OF INFORMATION
DIVISION OF PUBLICATIONS

FARMERS' BULLETINS
Nos. 1551-1575

WITH CONTENTS

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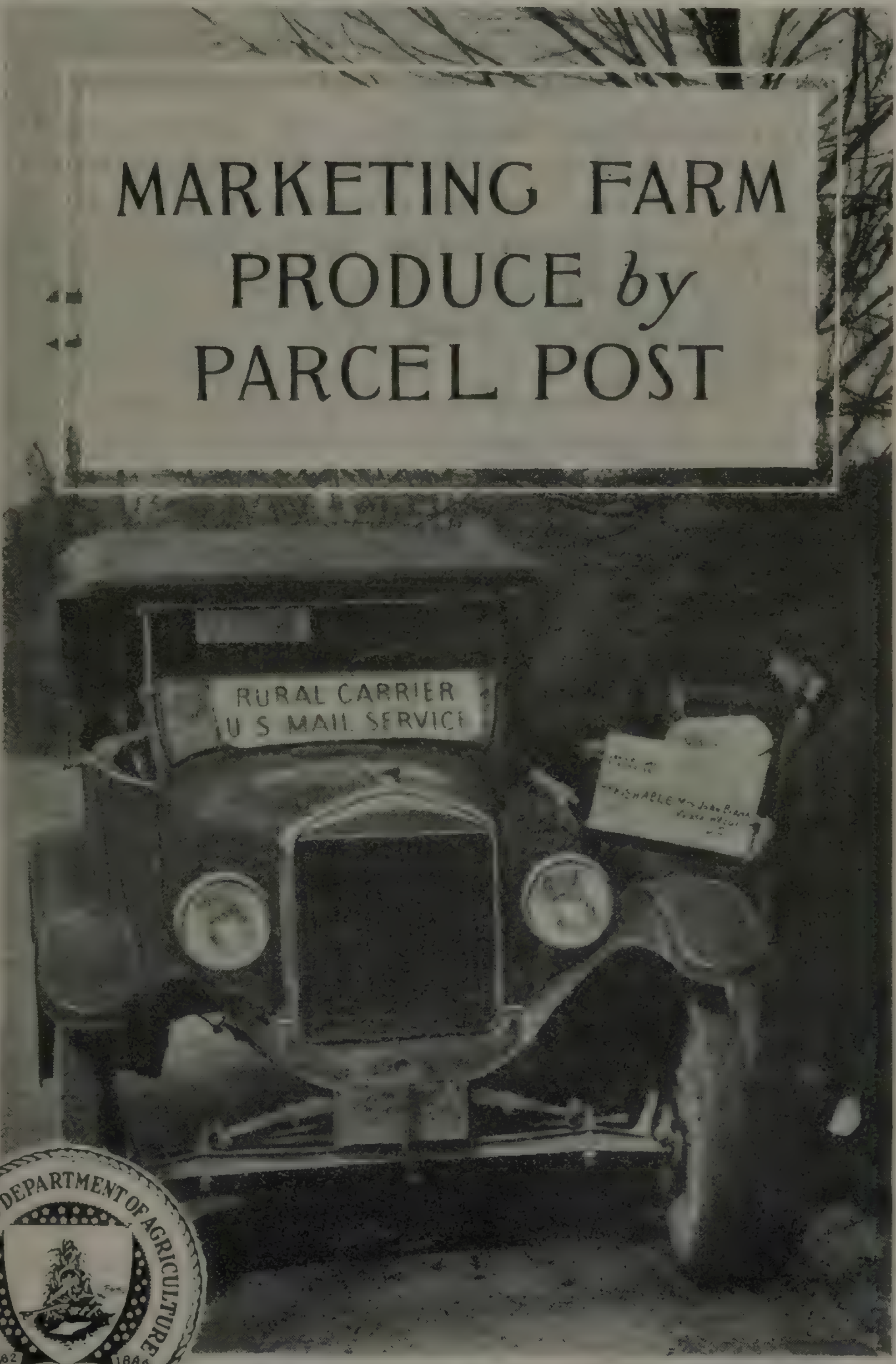
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1551

MARKETING FARM PRODUCE *by* PARCEL POST



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PRODUCER AND CONSUMER will find in this bulletin information as to possibilities of marketing farm products by parcel post. Parcel-post shipments of farm products have been slowly increasing in number since the establishment of parcel-post service, though they will always constitute but a small percentage of all farm products that go to market. Proper attention must be given to parcel-post requirements and containers, to methods of standardizing the products, to packing, and to the business phases involved. Dealing by parcel post succeeds if farmers pay proper attention to these things—always supposing that the consumer also observes good business methods from his end. Marketing by parcel post, within its limitations, is a useful means of marketing.

Although interest in parcel-post marketing is not as keen or articulate as it was when the subject was new, the demand for information on its possibilities continues. Produce sent direct to consumer will always constitute a comparatively small percentage of the total food supply because of the geographic distribution of production and the economy of carload transportation. Physically, the transportation by parcel post of nearly all kinds of farm products is a possibility, but economically it is not always justifiable. Marketing by parcel post or by any other means of transportation direct from producer to consumer is satisfactory only when the proper conditions exist.

Washington, D. C. Issued January, 1928

MARKETING FARM PRODUCE BY PARCEL POST

By Lewis B. Flohr

Marketing Specialist, Bureau of Agricultural Economics

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POSTAL REGULATIONS AND REQUIREMENTS

EACH PERSON interested in marketing by parcel post can readily become acquainted with postal regulations and requirements by consulting the local postal authorities. Most containers for commercial shipments used in other methods of transportation are admissible to the mails, provided they are in good condition and the contents are in good shipping condition. Measurements of parcels in girth and length added may not exceed 84 inches, nor may the weight exceed 70 pounds for the first three zones nor 50 pounds for the other zones. A general provision of postal regulations is that:

Articles of a perishable nature must not be accepted by postmasters for mailing unless they are in such condition at the time of mailing as reasonably to assure their arrival at destination and delivery in good order and in containers that will prevent the escape of any of the contents; this is obligatory in order to protect other mail matter and save loss to the owner.

All parcels containing perishable products like meat, butter, and cheese should be marked "Perishable," in letters large enough to be readily seen and may also be marked with the additional words "Keep from heat." All vegetables and fruits should be marked "Perishable," and eggs should be marked "Eggs" or "Eggs, fragile."

TABLE 1.—*Parcel-post rates*

[Parcel post must be fully prepaid—a fraction of a pound is computed as a full pound, and an additional charge of 2 cents on each parcel is made except upon those collected on rural-delivery routes. These rates, including the 2-cent additional charge, are shown in the following table and paragraph *a*]

Weight in pounds	Local[1]	Zones						
		First and second, up to 150 miles	Third, 150 to 300 miles	Fourth, 300 to 600 miles	Fifth, 600 to 1,000 miles	Sixth, 1,000 to 1,400 miles	Seventh, 1,400 to 1,800 miles	Eighth, over 1,800 miles
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	0.07	0.07	0.08	0.09	0.10	0.11	0.13	0.14
2	.08	.08	.10	.13	.16	.19	.23	.26
3	.08	.09	.12	.17	.22	.27	.33	.38
4	.09	.10	.14	.21	.28	.35	.43	.50
5	.09	.11	.16	.25	.34	.43	.53	.62
6	.10	.12	.18	.29	.40	.51	.63	.74
7	.10	.13	.20	.33	.46	.59	.73	.86
8	.11	.14	.22	.37	.52	.67	.83	.98
9	.11	.15	.24	.41	.58	.75	.93	1.10
10	.12	.16	.26	.45	.64	.83	1.03	1.22
11	.12	.17	.28	.49	.70	.91	1.13	1.34
12	.13	.18	.30	.53	.76	.99	1.23	1.46
13	.13	.19	.32	.57	.82	1.07	1.33	1.58
14	.14	.20	.34	.61	.88	1.15	1.43	1.70
15	.14	.21	.36	.65	.94	1.23	1.53	1.82
16	.15	.22	.38	.69	1.00	1.31	1.63	1.94
17	.15	.23	.40	.73	1.06	1.39	1.73	2.06
18	.16	.24	.42	.77	1.12	1.47	1.83	2.18
19	.16	.25	.44	.81	1.18	1.55	1.93	2.30
20	.17	.26	.46	.85	1.24	1.63	2.03	2.42
21	.17	.27	.48	.89	1.30	1.71	2.13	2.54
22	.18	.28	.50	.93	1.36	1.79	2.23	2.66
23	.18	.29	.52	.97	1.42	1.87	2.33	2.78
24	.19	.30	.54	1.01	1.48	1.95	2.43	2.90
25	.19	.31	.56	1.05	1.54	2.03	2.53	3.02
26	.20	.32	.58	1.09	1.60	2.11	2.63	3.14
27	.20	.33	.60	1.13	1.66	2.19	2.73	3.26
28	.21	.34	.62	1.17	1.72	2.27	2.83	3.38
29	.21	.35	.64	1.21	1.78	2.35	2.93	3.50
30	.22	.36	.66	1.25	1.84	2.43	3.03	3.62
31	.22	.37	.68	1.29	1.90	2.51	3.13	3.74
32	.23	.38	.70	1.33	1.96	2.59	3.23	3.86
33	.23	.39	.72	1.37	2.02	2.67	3.33	3.98
34	.24	.40	.74	1.41	2.08	2.75	3.43	4.10
35	.24	.41	.76	1.45	2.14	2.83	3.53	4.22
36	.25	.42	.78	1.49	2.20	2.91	3.63	4.34
37	.25	.43	.80	1.53	2.26	2.99	3.73	4.46
38	.26	.44	.82	1.57	2.32	3.07	3.83	4.58
39	.26	.45	.84	1.61	2.38	3.15	3.93	4.70
40	.27	.46	.86	1.65	2.44	3.23	4.03	4.82
41	.27	.47	.88	1.69	2.50	3.31	4.13	4.94
42	.28	.48	.90	1.73	2.56	3.39	4.23	5.06
43	.28	.49	.92	1.77	2.62	3.47	4.33	5.18
44	.29	.50	.94	1.81	2.68	3.55	4.43	5.30
45	.29	.51	.96	1.85	2.74	3.63	4.53	5.42
46	.30	.52	.98	1.89	2.80	3.71	4.63	5.54
47	.30	.53	1.00	1.93	2.86	3.79	4.73	5.66
48	.31	.54	1.02	1.97	2.92	3.87	4.83	5.78
49	.31	.55	1.04	2.01	2.98	3.95	4.93	5.90
50	.32	.56	1.06	2.05	3.04	4.03	5.03	6.02
51	.32	.57	1.08					
52	.33	.58	1.10					
53	.33	.59	1.12					
54	.34	.60	1.14					
55	.34	.61	1.16					
56	.35	.62	1.18					

[1] The local zone includes the mail service within the jurisdiction of the mailing office.

TABLE 1.—*Parcel-post rates*—Continued

Weight in pounds	Local	Zones						
		First and second, up to 150 miles	Third, 150 to 300 miles	Fourth, 300 to 600 miles	Fifth, 600 to 1,000 miles	Sixth, 1,000 to 1,400 miles	Seventh, 1,400 to 1,800 miles	Eighth, over 1,800 miles
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
57	0.35	0.63	1.20					
58	.36	.64	1.22					
59	.36	.65	1.24					
60	.37	.66	1.26					
61	.37	.67	1.28					
62	.38	.68	1.30					
63	.38	.69	1.32					
64	.39	.70	1.34					
65	.39	.71	1.36					
66	.40	.72	1.38					
67	.40	.73	1.40					
68	.41	.74	1.42					
69	.41	.75	1.44					
70	.42	.76	1.46					

More than 50 pounds can not be sent over 300 miles, that is, beyond the third zone. Rates on all articles are the same.

(*a*) Parcels subject to the pound rates, mailed for delivery within the first or second zone, are, when the distance by the shortest regular mail route from the office of origin to the office of delivery is 300 miles or more, chargeable with postage at the rate of 8 cents for the first pound and 2 cents for each additional pound, a fraction of a pound being computed as a full pound.

NOTE.—On parcels collected on rural-delivery routes the postage will be 2 cents less than shown in the foregoing table, provided they are indorsed "Mailed on rural route" to show that they are not subject to the additional charge.

SENDER'S RECEIPT FOR ORDINARY PARCEL

When desired a receipt is furnished the sender of an ordinary parcel by the mailing office upon payment of 1 cent. This fee does not insure the parcel against loss, and no receipt is obtained from the addressee on delivery. It merely serves as evidence of mailing.

ADDRESS AND SENDER'S "CARD"

Each parcel should be plainly and completely addressed on the parcel itself, as tags are liable to be torn off in handling. It is also required that the word "from" and the name and address of the sender be placed in the upper left-hand corner of the face of the parcel upon which the address appears; this is what is referred to as the sender's card.

INSURING PARCELS

A parcel may be insured up to $5 value for 5 cents; up to $25 for 8 cents; up to $50 value for 10 cents; and up to $100 value for 25 cents. The insurance fees are in addition to the postage and must be prepaid with stamps affixed to the parcel. A receipt for delivery of an insured parcel may be had on payment of a fee of 3 cents.

PARCELS COLLECT ON DELIVERY

The value of a parcel may be collected on delivery and returned to the sender. The fee for collection on delivery is 12 cents for value not to exceed $10, 15 cents for collections not to exceed $50, and 25 cents for collections not to exceed $100.

WRITTEN INCLOSURES IN PARCELS

No written communication may be inclosed in a parcel, as such inclosure would subject the parcel to first-class postage rates, but a statement as to the contents of the parcel and the prices of each item, with the total, may be inclosed. This must not include such statement for any other parcel sent at the same or another time.

PURE FOOD LAWS

In shipping farm products to or through another State the Federal pure food laws must be observed. Full information on these are published in Office of Secretary Circulars 21 and 136, which may be had by addressing the United States Department of Agriculture.

ECONOMICS OF PARCEL-POST MARKETING

Farmers can make extensive use of parcel-post marketing under certain conditions if they will. One of the chief factors in preventing the satisfactory development of parcel-post marketing has been the price asked by some farmers for produce. To illustrate: One farmer's wife was receiving 20 cents a pound for butter in her local market, a country store. When asked if she would be willing to ship it to a city by parcel post and at what price, she replied that she would do so at 50 cents a pound. On the other hand, would-be purchasers frequently have been known to offer producers a lower price than they can obtain in their local markets. It is needless to say that such imperfect and erroneous ideas as to equitable prices defeat the possibility of marketing produce satisfactorily by parcel post. Business in marketing by parcel post can be secured and held only by shipping produce of high quality and by charging reasonable prices.

It must be understood that there is nothing magical about marketing by parcel post. Every producer considering marketing by this medium should carefully compare the possible net returns by this method with the net returns by other methods and reach a conclusion as to which serves his purpose best. Since motor transportation has made it much easier for the farmer to reach markets and since the chain stores now handle many of the more perishable farm products, there is less attraction than formerly to both farmer and city or town consumer in marketing by parcel post.

Roadside marketing is direct marketing; many farmers may find this preferable to marketing by parcel post.

The larger the quantity, within the postal limits, that is shipped at any one time the more economical is the factor of postage and therefore the more attractive from the viewpoint of cost both to the producer and to the consumer. This applies both to shipments and to the return of empty containers. It would not be economical for a consumer to secure half a dozen different kinds of vegetables from as many different producers, but if a supply of half a dozen kinds of vegetables and fruits could be obtained in one parcel from one producer it might be both advantageous and attractive.

In the first and second parcel-post zones a 5-pound parcel would cost 9 cents postage, plus the service charge of 2 cents—11 cents in all, or $2\frac{1}{5}$ cents a pound. A 20-pound parcel would cost 26 cents postage and service charge (24 cents postage plus 2 cents service charge) or 1.3 cents a pound, while a 70-pound parcel would cost 76 cents in all or $1\frac{3}{35}$ cents a pound. This illustrates the more economical cost of transportation on the larger parcel. In view of the relatively higher costs of postage on smaller parcels, the consumer should order as large a shipment as he can use without loss, so as to reduce the transportation costs to as low a point as possible, for, in the final analysis, the consumer pays the postage costs in the price of the commodities he buys.

Another item of economy to the producer is that his mail box or local post office becomes his shipping station. This relieves him of an extra trip in order to make shipment, as the rural mail carrier takes the shipment from the mail box or some member of the farmer's family deposits it at the post office when calling for the mail.

Farmers often have small surpluses of produce, not needed for home consumption, which can be marketed if some ready means of getting it to a customer is available. The parcel post supplies this medium. There are also many supplemental or side lines of production which can be developed for the same purpose.

Mutual confidence and helpfulness are needed in order to succeed; cooperation is needed. Consumers are interested in buying by parcel post only when they can secure more satisfactory produce or some advantage in price or both. The producer is not interested in marketing by parcel post unless it means some additional net return to him. A high quality of produce, well prepared, carefully and attractively packed, and forwarded so as to reach its destination at the time desired, will go a long way toward the establishment and continuance of business. Ordinary or inferior produce often loses a customer and hinders the producer in gaining others. The producer must aim to give satisfaction by supplying his customers, as nearly as possible, with produce which meets their individual needs. The consumer must also aim to give satisfaction by caring for and returning containers, by making prompt remittances as agreed upon, and by doing his part in all phases of the transaction. In other words, a square deal is needed.

Parcel post is used by producers to make shipments of butter, eggs, and other commodities to wholesale or other mercantile houses, and to make shipments of cream to the butter factory.

ESTABLISHING BUSINESS RELATIONS

In practically every city there are persons who wish to buy fresh produce direct from the farmer, while within 150 miles (first and second parcel post zones) of these cities there are many farmers who wish to market their produce by parcel post. The bringing of these persons into business contact is one of the most difficult problems of parcel post marketing.

FRIENDS AND RELATIVES AS CUSTOMERS

Naturally, first contacts are with friends or relatives. For producers who wish to market by parcel post the most satisfactory way of finding customers is to write to friends, relatives, or acquaintances in cities, seeking their trade. Purchasers often can locate reliable producers by correspondence with friends, relatives, or acquaintances in the country. More than 75 per cent of the produce being marketed by parcel post in a number of cities in which investigations have been made is sent by persons who obtained their customers through friends, relatives, or acquaintances.

Making business contact is less difficult between friends because of the absence of the suspicion and distrust that sometimes is found between strangers. Many persons will not order farm produce from strangers because they do not know the conditions under which the articles are produced, nor the business capacity or the integrity of the farmer.

The method of establishing business relationship through friends is especially recommended for the general farmer who has a limited amount of produce. Those who wish to market a great deal of produce by parcel post will find it necessary to obtain customers by personally soliciting strangers, or by advertising in newspapers, or by other means.

SEEKING CUSTOMERS AMONG STRANGERS

Such a farmer would do well to write to acquaintances, asking them to recommend him to others or to supply him with the names and addresses of reliable acquaintances in town who might be interested. The farmer should try to induce such friends to act as city references by answering inquiries as to his dependability and by giving general information. He should supply them with full information. Where the business is to be on a scale which warrants the expense, it should be found effective to supply friends with neatly printed circulars describing the plan and giving lists and prices of produce.

To obtain satisfactory results from advertising, the newspaper selected must have a concentrated circulation among persons to whom the advertisement would appeal. A local church paper might serve the purpose satisfactorily. Usually advertising is not profitable for the general farmer, but often gives satisfactory results to the producer who specializes in some product that can be shipped throughout a considerable part of the year.

Advertisements should be short and should give a description of the goods with the prices, and the name and address of the person advertising. In some cities the Sunday edition of a newspaper gives better results than the daily edition. The person who advertises must offer a product that is wanted by the persons who read the paper at the time the product is advertised, in the places where the paper has a circulation. In other words, he must know what to advertise, when to advertise, and where to advertise.

Mimeographed information and price letters are cheaper, and the producer can make them himself. Mimeograph outfits are relatively inexpensive; as a last resort, hand-written copies can be used.

Circulars sent direct to the hoped-for customer by mail, to succeed, must include two features—the product appeal and the right selection of the "prospect." Prospective customers can be selected from telephone or city directories, as the directories usually give some clue to kind of business and to residence location. From club membership list and church news good prospects can often be selected. In all instances the names of heads of families should be used. A knowledge of the better residence portions of the city involved is an essential.

The "product appeal" must be such as to arouse appetite and therefore interest. For instance, in the fall when the weather begins to be cold, something like the following, especially to a former satisfied customer, will usually bring results: "Our all-pork home-made sausage is in season again—easy to get, hard to keep (because so good to eat). Three pounds delivered to your door, $1." The name and address, naturally, must be included.

The following advertisements are given merely as suggestions; the wording can be changed to meet the conditions of each farmer:

Fresh eggs direct from farm. Send — for 3 dozen delivered by parcel post prepaid. Fair View Farm, Blank, Va.

Butter direct from dairy. Fresh, clean, and sweet. Send — for 2 pounds delivered postpaid by parcel post. Fair View Farm, Blank, Va.

Fresh vegetables for the family. Quality guaranteed. Send — for basket of assorted vegetables delivered postpaid by parcel post. Fair View Farm, Blank, Va.

Cherries from the tree to you by prepaid parcel post. Picked the day they are mailed. Send — cents for — quarts to Fair View Farm, Blank, Va.

Form letters, circulars, or cards sent to a selected list of persons have been suggested as means of obtaining customers for produce by parcel post. In some cases this plan has not been successful. Persons who wish produce of high quality sometimes will not order from a stranger who has not been recommended. The cost of obtaining customers by circularizing is often relatively great, and unless the names of persons to whom the circulars are sent are selected very carefully this method can not be especially recommended.

Customers may be obtained by making a personal canvass in a selected neighborhood in a city. The neighborhood should be one which is not supplied with many markets or green-grocery stores. A suburban district of homes with good incomes offers a good field in which to solicit trade, for in many such districts the delivery service of the groceries is not as satisfactory as in the city.

Success in making a personal canvass depends in a large measure upon the personality of the person making the canvas. He should state his business clearly and concisely, showing the prospective customer why it is advantageous to buy produce by parcel post. He should be neatly dressed, as it is naturally assumed that a person who is careless in other matters will be careless in the preparation of his produce. It is advisable to have samples to show what can be furnished. The samples should represent honestly the produce to be supplied; if they misrepresent, failure is sure to follow. Cards giving the name and address of the producer and the nature of his marketing are useful. A personal canvass usually results in more customers than does advertising or the sending of form letters, as most customers prefer to know the person with whom business is transacted.

If the producer's farm is on or near a much-traveled road, an attractive farm bulletin board placed conspicuously near the road is a help in making business contact, for many city dwellers travel far out into the country by automobile. This method will be especially useful on clean, well-kept farms. The statements on the board should give the articles for sale, together with their prices delivered to the purchaser's door by parcel post, and the main items should be in lettering large enough to be read quickly. This plan has enabled a number of producers to secure all the customers they could supply.

Warning notices might be placed at a proper distance in each direction from the main bulletin board. The wording on these warning boards should be brief but pointed, as, "Fair View Farm. Read Marketing Bulletin Ahead."

HOW A CONSUMER CAN FIND A PRODUCER

Many city dwellers who spend a summer vacation in some neighboring country district can make it their business to become acquainted with farmers and complete arrangements for buying produce by parcel post. In parts of Europe many families consider the making of such arrangements an important feature of their vacation trips. Similarly, a farmer can make desirable connections by meeting city people on their vacations. Such meetings make it possible to settle all details and allow the customer to judge in advance the quality and character of the produce.

Sometimes, under such conditions, it is possible for city consumers to enter into arrangements with a farmer or gardener whereby he will agree to increase the amount of vegetables he grows in his farm garden and to raise certain specialities which the customers may wish to buy. This can even be extended into a sort of partnership arrangement in which the farmer manages a country garden to supply the city consumer's table. Under this arrangement the city consumer practically has a kitchen garden of his own, though it may be many miles distant.

In some instances the consumer will wish to make contact with a producer by inserting an advertisement in some paper known to circulate in the section of country in which he thinks a suitable producer may be found. A suggested form for such an advertisement follows:

> A Baltimore family of six wants a gardener or truck farmer to supply it regularly with fresh assorted vegetables by parcel post once a week throughout the year. For particulars address —.

The number constituting the family to be supplied, the frequency of shipment, and the portion of year during which the shipments are desired can be stated. For instance, some families might need shipments twice a week as a rule, but might want none during July and August because of absence from the city.

TRIAL ORDERS

The producer who wishes a customer may seek the privilege of making a trial shipment. A plan for the trial shipment should be worked out completely, so that the prospective customer can be shown the quality, quantity, and general variety that can be shipped and the total cost for such a shipment delivered at his house. If possible, the size of the customer's family should be learned and an offer made of a shipment that will supply fresh vegetables to such a family for a specified number of days.

If the prospective customer is known to be reliable, the farmer should be willing to make the first or sample shipment at his own risk. The condition should be made that the customer is to be judge of value received and that if the goods in the trial shipment are not entirely satisfactory in quality or in price, the customer's opinion as to what they are worth will be accepted and the bill adjusted or a refund made. Where the reliability of the prospective customer is entirely unknown to the producer it is preferable to have a cash transaction with the first order. The producer should remember that the customer has no more business reason for trusting him than he has for trusting the customer, and he should make it clear that he will be glad to make any adjustment necessary in the transaction so as to leave the customer entirely satisfied.

The situation is exactly reversed when the city family seeks to induce a farmer to ship products. It is only fair to send cash with the first order and continue the cash business until credit arrangements satisfactory to both sides can be established.

RECORDS AND CORRESPONDENCE

A book should be provided so that a record can be kept of each shipment. It should provide a permanent record of the date of shipment, customer's name and address, the product and quantity sent, the price and amount of bill, and the weight of shipment. Other items of value may be recorded, as kind and cost of container, credit for return of containers, net amount of bill, and date of payment.

The form shown below provides for such a record. The keeping of records of this kind requires considerable work, but is desirable if the business is large. Such columns as are not wanted can be omitted from the form. If a farmer is shipping to but one or two customers it may not be advisable to keep such complete records, but some record should be kept of every shipment. If shipments are made to a number of persons an alphabetical list of customers can be kept.

FORM.—*Suggestion for record of shipments*

Date of shipment	Customer's name	Address	Quantity shipped	Kind of produce

In conducting a mail-order business much depends on correspondence. As comparatively few persons like to write letters, producers should do all they can to carry on direct marketing in such a way as to require few letters from their customers. But the very nature of mail-order business, even with the use of the most simplified system, necessitates correspondence. Farmers must answer correspondence and inquiries from customers or prospective customers. This should always be done promptly, whether the answer is favorable or not. Many persons who have had their names listed by postmasters as willing to supply produce by parcel post have failed to make reply when they received inquiries. Business can be secured and retained only by using businesslike methods, which should be simple but which must be prompt. The name and full address of the writer should always be given, as failure to do this often prevents reply to important business correspondence. A regular letterhead will be found useful. A simple and businesslike printed letterhead can be obtained without much cost. (See form.) It should give the name and location of the farm, the farmer's name, and may give a simple statement of the business. Elaborate and highly colored letterheads with illustrations of buildings, fruits, or animals should be avoided.

FORM.—*Suggestion for letterhead*

FAIR VIEW FARM
John Brown, Proprietor
Produce Shipped by Parcel Post Direct from the Farm

Blank, Va., _____________, 192__.

SIMPLIFYING MAIL ORDERS

The first letter sent by the producer, in seeking to establish parcel post marketing relations, should explain the plan clearly and should tell the customer exactly what can be furnished and how much, exactly the amount of money the goods will cost delivered, and when and how they will be delivered. Similarly the customer in seeking a producer should tell as explicitly as he can what he wants, when he wants it, and should give a general idea as to prices. The first letter also should establish clearly the reliability of the writer. Unless all these points are fully covered at the start, both producer and consumer may feel uncertain about proceeding further in the matter.

BLANKS AND FORMS

Blank statement forms or invoices to fill in and inclose with shipments should be used to save trouble. The price can be entered on a blank piece of paper, but the use of a printed statement form is recommended for those who send produce to persons who pay at stated times. The following form may be used either for an invoice with each shipment or for rendering a monthly statement. A bill or statement covering more than one shipment must not be inclosed in a parcel, as it is first-class mail matter.

If a carbon copy of the invoice or statement is made, it can be retained as a record of the transaction.

FORM.—*Suggestion for bill or statement*

BLANK, VA., ________________, 192__.

M ______________ Dr.
____

To FAIR VIEW FARM

JOHN BROWN, Proprietor.

Year and month	Day of month	Quantity	Article	Price	Amount	Remarks

FORM.—*Suggestion for record of shipments*

Kind of container	Weight		Local country price	Cost of container	Postage	Amount of bill	Credit for container returned	Net amount of bill	Date of payment
	Lbs.	Oz.							

REDUCING HANDWRITING TO A MINIMUM

The plan which calls for the least correspondence is the regular weekly shipment of a definitely priced quantity or an assortment of products, the producer first learning what the consumer wants and what he does not want. If this plan is not used it is necessary for the farmer to send his customers, from time to time, a list of the products he has for sale and their prices. The customers then make up their individual orders.

The writing of a list each week by hand will be found troublesome, particularly if the producer has several customers, each of whom must be supplied with a copy. This labor may be avoided by having printed or mimeographed lists of all the products that will probably be available for sale during the season. After the name of each product there should be a blank space in which the current price of that product may be entered. Before each name another blank space should appear, in which the customer can enter the amount of that product wished. He can then return the list as an order. As shown in the accompanying form, this sheet can be so worded as to constitute a price list, an order blank, and a statement of products which will be available one or two weeks ahead.

FORM.—*Suggestion for order blank for cash customers*

______________, 191__.

To Fair View Farm, Blank, Va.:

Inclosed find $______, for which please send me by parcel post, charges prepaid, items I have checked.

______	doz. eggs	@ ______	per doz.	$______
______	lbs. butter	@ ______	per lb.	______
______	lbs. dressed poultry	@ ______	per lb.	______
______________________		@ ______	per ____	______
______________________		@ ______	per ____	______
Total______________________________				______

Sign here ______________________________
Street and number ______________________
City ________________ State ___________

Postage extra beyond second zone.

The same blank could be used for credit customers by striking out the words "Inclosed find $______ for which."

An easier means of sending out price lists for securing orders is the double or return postal card. The list should be printed on the back of the return half of the card and the producer's name and address written or printed on the face. The first or initial half of the card should bear on its face the name and address of the customer, and the back may be used for comment on the availability of certain fruits or vegetables or for other necessary correspondence. The customer can tear off the reply half, indicate the amount of each article wanted, sign his name, and mail the card. This system costs in postage but little more than one letter, whereas the system outlined in the preceding paragraph requires two letters—one from the farmer to the customer and one in return.

Another plan is for the producer to have his list of articles printed on single postal cards, with spaces for him to enter prices and for the consumer to enter the order.

Should the farmer not care to buy stamped cards, he can have the price list printed on the back of a self-addressed mailing or post card, which is forwarded to the customer in an envelope. The customer needs only to fill in the card, affix the necessary postage, and mail.

The cost of issuing a price list in blank could be reduced materially by the cooperation of several farmers. Such a list should show all the products raised by the group, but could be used by the individual producer in dealing with his own customers. Where such brief forms are used the farmer should occasionally write a personal card or note to his customer to show interest, explain seasonal changes in the nature of shipments, or furnish information as to fruits or vegetables soon to be ready for market. This may be done on the initial half of the return postal card. If possible, space should be left on the return half of the postal card for the customer to note the condition of the previous shipment or make suggestions as to goods wanted.

ARRANGING PRICES

Many farmers have an erroneous idea as to the prices that city dwellers pay or are willing to pay for farm produce. On the other hand, not a few city purchasers think that the farmer receives a low price for his produce when he sells it. In attempting to market by parcel post, farmers too often ask exorbitant prices, and city consumers often expect to receive produce at prices which would allow no profit to the farmer if he sends small quantities by parcel post.

Consumers will not pay more than the city price unless a superior article is obtained. Farmers will not market by parcel post unless they can obtain enough over the price otherwise obtainable to pay for container, postage, and extra labor. A proper understanding of both sides of this question will assist both producers and consumers in agreeing on prices. Consumers should bear in mind that many farmers who have local markets sell ungraded or partly graded produce, and if graded produce of high quality is furnished by parcel post a higher price must be expected.

It is advisable to have some basis from which to figure prices of certain kinds of produce, as misunderstandings and distrust about prices have caused much dissatisfaction with direct marketing. The use of the local country price or the wholesale city price as a basis has proved satisfactory in most cases. The farmer can readily ascertain the amount that he must charge above his local price when he considers the cost of container and postage and the extra labor involved. If satisfactory to both, a contract price for a stated period can be made. An agreement must be reached as to whether the price includes all charges for produce, container, and postage. It has been found that purchasers usually prefer to have quoted to them a price which includes all charges. Whatever agreement is made as to prices the farmer should abide by it strictly and give his customers no cause for distrust.

The fewer changes in prices the easier the business is to transact and the better satisfied the customer will be, provided the goods and prices are right.

PRICES BY THE YEAR

Because of unequal production and wide variation of prices it is often difficult for persons to agree on a uniform year-round price for produce engaged by the year. Only when the producer can fill orders at all seasons and each party is sure of the reliability of the other is this plan feasible. Usually when eggs or other farm products are high in price and production is small, the farmer must stop shipments temporarily, which is hardly fair to the consumer who has paid more than the market price through the summer with the expectation of receiving produce in winter at a price lower than the market quotations. Nor is it fair, after the farmer has shipped eggs at a low price through the winter, for his customers to inform him that they are to take a vacation of a month and will not need eggs during a month when he has been expecting to make a profit. But in all cases where a standing price can be made satisfactory at both ends it is to be recommended.

CITY MARKET REPORTS

Many farmers and most city consumers have access to daily market reports in the newspapers and can base prices on them. Unfortunately, such reports vary in different newspapers, and often producers and consumers do not see the same reports, but where both receive the same newspaper the market reports may prove satisfactory as a basis.

ALLOWING THE FARMER TO NAME THE PRICE

If an order blank is not used and the consumer is assured that the farmer understands business methods and is conscientious and fair-minded, he may allow the farmer to set the prices after the order is received. Protests may be made at any time, and if developments are unsatisfactory trade may be stopped. Many consumers have used this method with satisfaction to themselves and the farmer. The local country price may be used by the farmer as a basis from which to determine the amount to be charged. There is danger that some producers will overcharge because of an erroneous idea of city market prices or because of a lack of knowledge of basic business principles. Reports of high city retail prices should not receive serious consideration as a basis, for such high prices usually are of short duration and often represent the sales of fancy articles to a few wealthy consumers.

ALLOWING THE CONSUMER TO NAME THE PRICE

Some farmers furnish produce at prices that are decided upon by their customers, but this plan is acceptable to very few farmers. Consumers can use their city retail market price as a basis for determining what they care to pay. For this plan to be satisfactory to both parties the consumer either must effect a saving or obtain a better product, while the farmer must receive a better price than he can get at his local market.

FIGURING PRICES IN ASSORTMENT SHIPMENTS

Unless confidence between buyer and seller has developed to such an extent that the producer feels free to ship on his own judgment, with the certainty that the consumer will accept his price as fair, the producer who is selling from list must give great care to determining the gross price he is to ask and his net profit. This is somewhat difficult, as the producer must bear in mind the bulk and weight of vegetables and fruits, the weight of container and packing, and the bulk that he can get into a package, with reference both to postage and to size and weight limits of parcel-post packages. The cost in time and material for proper packing also must be considered. The shipments should be so adjusted that the quantity of each kind shipped will be enough for a proper serving of the consumer's family. In endeavoring to satisfy the customer the producer must bear in mind the retail prices for similar products in the cities. In making an assortment, especial care must be exercised not to include in it too much of a heavy and low-priced product but to give the customer good total value.

Possibly the easiest way for the farmer to make profitable assortments is to determine what he wishes to receive net for each product and then, after figuring out the weight or bulk of a typical portion, to add a proper allowance for postage and packing. If he can figure his price throughout in terms of pounds, it will be easier to figure the delivery price, including postage. But after some experience the producer should be able to distribute cost of packing and postage on a percentage basis. Under this plan he can easily determine how many pounds of each product he can afford to include for a given gross price, including postage.

When the price is to cover the return postage on the containers, this item should be included with the postage. The easiest plan of settling for postage on return of containers, if the customer buys the stamps, is to deduct this amount from the price of the next shipment following the return of the containers. An addressed return label for use on the empty containers can be furnished by the farmer.

ARRANGING PAYMENTS

Difficulty in arranging for payments hinders the growth of direct marketing. The farmer prefers cash in advance for his produce. This system is not satisfactory to many consumers because of the necessity of making frequent payments and because the exact price is not always known. But the farmer should never send produce without payment in advance to a stranger who has not exchanged recommendations with him. Although the majority of persons are honest and will pay for produce received by parcel post, unfortunately there are persons who order farm products without intention of paying. A few such losses will reduce the farmer's profits materially.

Consumers who have not been recommended should not expect producers to send goods by parcel post without having received payment. It is easier for producers to furnish satisfactory references than for many persons in cities, as in the country nearly everyone is known by the postmaster and the local banker. If a producer furnishes satisfactory references, the consumer should be willing to send cash in advance until the producer has opportunity to learn of the reliability of the person to whom he is sending produce.

If a prospective customer furnishes references, the producer before sending produce should write to the persons to whom he has been referred, as anyone, no matter how unreliable, can send the names of persons as references. In many instances producers have been satisfied when the mere names were furnished, and no effort has been made to ascertain the reliability of the person who sent the names. When unable to collect the money for produce sent these farmers have learned that the persons whose names had been used as references were no more reliable than those who had furnished the names. Persons whose names are furnished by prospective customers should be business or professional men if possible.

If a producer is satisfied as to the reliability of his customers, credit should be extended and settlements required periodically, say each month. This will prove more economical and satisfactory than the cash-in-advance system. An invoice should accompany each shipment and the bill sent in at the end of the month should be a summary and total of the various invoices.

Parcel-post shippers should consider that they are entering upon a small retail business, where they must necessarily encounter the disadvantages under which a retailer always labors. One of the most difficult of these is the proper use of credit. Some retail business houses have been ruined by the refusal of such credit, and many others have been ruined by the too liberal extension of it. When properly used, the extension of credit to parcel-post customers is often satisfactory, but it must be remembered that extending credit is a business proposition and requires a knowledge of business relationship.

The collect-on-delivery service of the Post Office Department may be used to advantage when sending packages of considerable value, but it is thought by most persons to be too expensive for ordinary farm-produce shipments. When this service is used it eliminates the danger of loss of payment.

ADJUSTING DIFFERENCES

The producer who establishes a mail-order business in farm produce must expect to receive complaints. Upon receipt of a shipment, a customer may be dissatisfied with the quality or appearance of the produce, which may have been caused by rough handling or delay in delivery. Sometimes, when shipments of this kind are received, a customer writes a letter to the producer accusing him of unfair business methods. In instances of this kind the producer may be tempted to write a discourteous letter in reply, but he must bear in mind that no business man can afford to do so, no matter how unfair the letter received may seem.

The success of persons who have sold goods by means of mail orders is due largely to their guaranty to give satisfaction or to refund the money. Because they have adhered strictly to this guaranty the confidence of the buying public has been firmly established, and through recommendations of satisfied customers the business has grown from year to year. Many customers who were dissatisfied with the quality of produce received from a person who sold by mail later became satisfied customers and good advertisers because of a prompt adjustment of the matter. There is no better way of establishing confidence and eliminating distrust than by the prompt adjustment of differences. If a producer becomes convinced that a customer is unfair and unreasonable, he should write a letter telling him that his trade is no longer desired. This letter should never be discourteous, if for no other reason than because antagonism never pays profits to a person in business.

If, in all dealings, a producer is prompt, fair, and reliable, he will be able to obtain and retain business that otherwise would be lost. A producer who undertakes a business in parcel-post marketing can not hope to make great profits nor to build up a large business in a short time, but proper business relations with consumers will increase business and aid in success.

AGREEMENTS

The nature of the agreement, whether reduced to writing or not, should be made to suit the circumstances and must be fair to both. Some may wish to have the first agreement in writing; but later, if mutual confidence has been thoroughly established, the contract may be verbal.

The agreement, if written, should specify: (1) Names of the parties to the agreement, (2) length of time during which the agreement is to be in force, (3) quantity of produce to be shipped periodically during the time the contract runs, (4) price to be paid during the time of the contract, together with the base on which the price is fixed, (5) method of adjusting claims, (6) that the consumer is to open containers properly (without damaging), take proper care of them, and return them by mail if desired by the producer, and (7) frequency of payment and manner of remitting; postage paid on empties returned to the producer to be credited to the consumer on next bill rendered.

CONTAINERS

The cost and treatment of containers have much to do with success in marketing by parcel post. A container should be cheap, neat, and light. The amounts involved in most parcel-post shipments of farm produce do not warrant the use of an expensive, heavy package because of the first cost and the charges for postage. The container should be adapted to the particular produce shipped and should be whole, in good condition, and clean.

The trouble of returning empty containers often influences people to discontinue parcel-post buying. The city dweller has little room to keep containers, and it is not practicable to return them singly, for the relative cost of postage is high on small parcels. But it is often inconvenient to take a bulky package to the post office. If the customer can not conveniently store them and return a number at one time the producer should, if possible, use containers that are cheap enough for a single service. Containers should never be bought with price as the only consideration, however, as they should be strong enough to carry the contents safely. For many shipments, cheap splint baskets are satisfactory and the cost is so small as to make their return unnecessary.

Many containers are made in "knockdown" style; that is, they can be taken apart and folded into a much smaller package. Containers which are knocked down to be returned should be so packed that no edges or points project without support or protection, as such projections are likely to be broken or crushed in the mails.

Since the return of containers will have some effect on the price of purchases, the spirit of thrift should cause the consumer to take care of all returnable empties and to send them back in accordance with whatever agreement or understanding may exist.

APPEARANCE OF PARCELS AND PRODUCE

The appearance of the parcel depends almost entirely upon the manner in which it is prepared. A supply of good, tough paper of the proper size to wrap parcels and good, strong, though not a heavy cord or twine, that stretches very little, should be obtained. Whatever the nature or style of container, it should be of good appearance, for the appearance of the parcel when it is delivered often determines the attitude of the customer toward the contents of the parcel.

The consumer has come to expect a uniform product and will not be satisfied with a shipment of miscellaneous ungraded produce. As the sending of anything but high-grade material will result in failure to retain trade, and as many persons have discontinued ordering produce by parcel post because they received one shipment that was unsatisfactory in quality, it is better for a producer to decline an order than to send goods not up to a satisfactory standard. The produce should be uniform in size, color, and quality and should be packed so that the contents and container will carry properly, arrive in good condition, and present a satisfactory appearance.

Quality is important and should be uniform. With many consumers it is more of an object than is price. Probably more produce is judged by appearance than by quality; the two should go together. Some farmers are prone to think of the likes and dislikes of the purchaser as whims and fancies, whereas, as a business principle, he should endeavor to cater to the wishes of his customers. It is known that white eggs sell better to certain trade in New York, while brown eggs bring a premium in Boston. The average farmer cares little whether eggs are white or brown, but this indifference should not overrule any preference the customer may have expressed.

VARIETIES OF PRODUCE AND CONTINUOUS SUPPLY

Many persons do not market by parcel post because they do not have a large variety of produce or because their supply is available only part of the year. A continuous supply of a number of products is more satisfactory to customers, but such a supply is not absolutely necessary in order to establish a parcel-post trade. Many persons have secured customers by specializing in one or two kinds of produce, such as butter or eggs, which can be supplied during the entire year, and then these customers have offered an outlet for other commodities which can be furnished only occasionally or for produce which is rarely to be had on city markets. In most of these cases it was necessary only to send a letter or card to satisfied regular customers asking them if they wished to obtain certain kinds of produce that were for sale at that time. Such letters tend to keep up a personal relationship between the producer and his customers, which makes it easier to keep up business relations. It should be kept in mind, however, that a constant supply to fill all orders and avoid disappointments is an important factor in building up and maintaining a business.

FRUITS AND VEGETABLES

The Bureau of Agricultural Economics, United States Department of Agriculture, has established standard grades for most fruits and vegetables. In cases where customers wish such grades to be used the producer can obtain copies of the grade standards and specifications by writing to that bureau for them. These standardized grade specifications have been used as the basis of the general suggestions that follow as to grading the various fruits and vegetables.

FRUITS

APPLES (UNITED STATES STANDARD GRADES ESTABLISHED)

Apples lend themselves readily to parcel-post marketing. There is a promising field for shipping fancy eating apples direct. As cooking apples are lower in price they can not be marketed as economically direct to the consumer. But when there is sufficient difference between the market price the consumer has to pay and the price the producer can obtain, even cooking apples may be so marketed.

Any container which will carry the apples safely and protect them from damage can be used. The container must be such as to keep the pack in good shape and must be tied or otherwise secured, so that the fruit will not be bruised from handling in the mails. Small quantities may be shipped in climax or splint baskets if well packed, as shown in Figure 1; larger quantities require more substantial containers.

Apples should be well-grown specimens, the proper shape and size for the variety, of normal color, and never overripe. They should be sound, clean, free from damage by worms or other pests, free from disease, skin punctures, or other defects. No fruit that has fallen to the ground should be used for direct marketing.

CHERRIES (UNITED STATES STANDARD GRADES ESTABLISHED)

All cherries should have the stems on and when possible should be clipped from the tree with scissors instead of being pulled. They should be gathered at the proper state of maturity but should not be overripe. Cherries pulled from the stems decay quickly. Unless the customer agrees to have them pulled from the stems that method of picking should not be used. Soft, bruised, overripe, bird-picked, hail bruised, and all other defective fruit should be kept out. The accompanying illustration (fig. 2) shows four 8-quart crates of cherries that had actually been shipped by parcel post. As cherries are too tender to ship in bulk, as in a peck or one-half bushel basket, containers supplied with 1-quart baskets or boxes should be used.

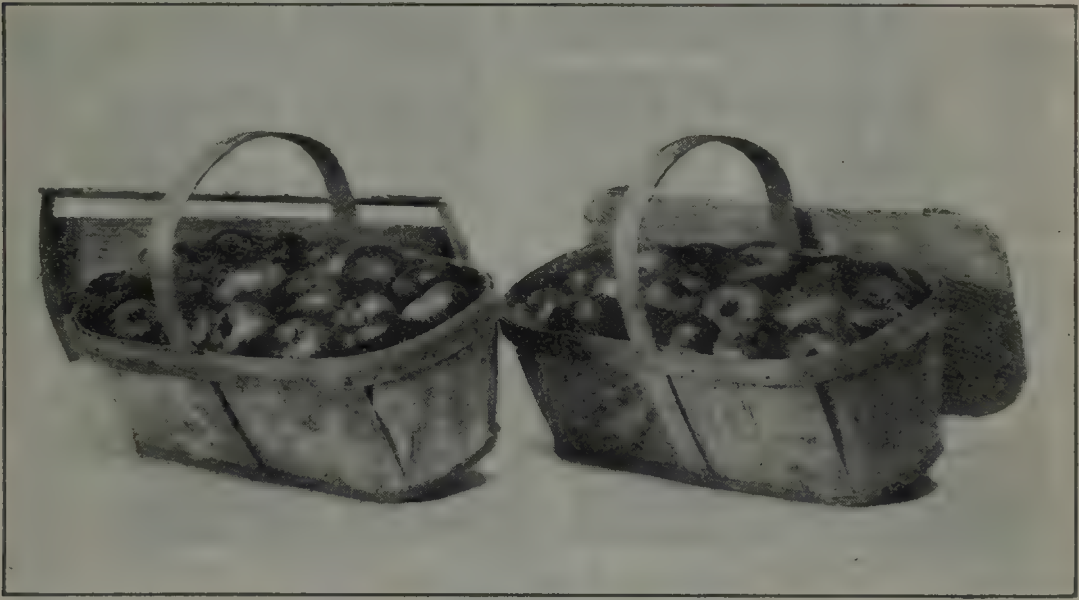

FIG. 1.—A good pack of apples in climax baskets. The style of lid, left basket, allows a fuller, rounder pack

CITRUS FRUITS (UNITED STATES STANDARD GRADES ESTABLISHED FOR ORANGES AND GRAPEFRUIT)

There is practically no physical difficulty in shipping citrus fruits—oranges, grapefruits, lemons, and limes—by parcel post. Postage cost is the factor to consider. Limes are not heavy for their value, and it is possible that small containers carrying a quantity suitable to the soft-drink dispensing trade might make possible a more satisfactory system of distribution than exists at present. Few private homes use enough limes to justify their shipment direct unless they are included in an assorted shipment. The ordinary commercial containers carry citrus fruits satisfactorily by parcel post. For small quantities a crate of half the size of the commercial ones prove satisfactory.

CURRANTS

(The bush currant, species Ribes, not the small raisin known by the name "currant.") Currants should be picked before becoming overripe, and only stems that are fairly full should be included. They should be picked and packed when dry, kept cool, and marketed promptly, as mold develops on them very quickly. They should be shipped in containers supplied with 1-quart baskets or boxes.

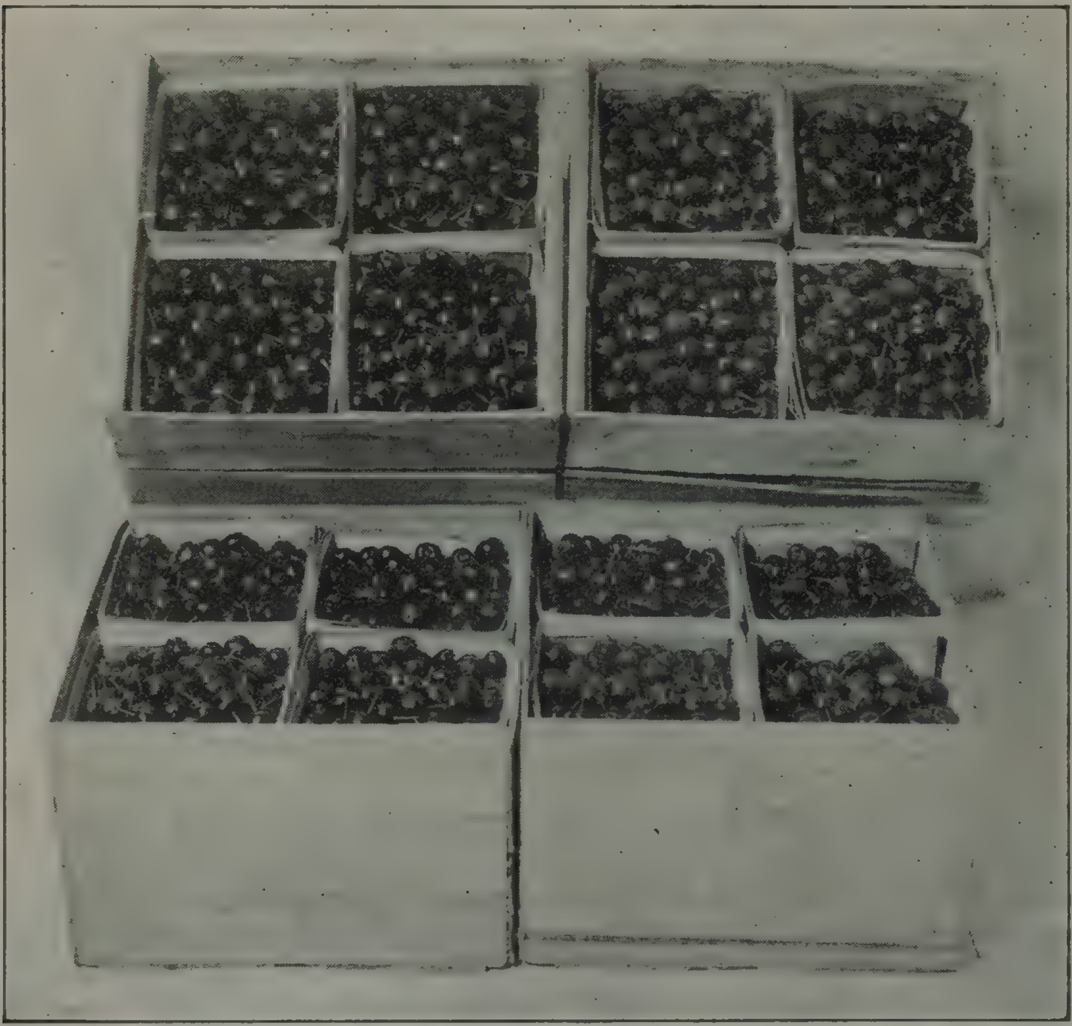

FIG. 2.—Four 8-quart crates of cherries shipped by parcel post. Each crate has two decks or tiers of 1-quart boxes

GRAPES (UNITED STATES STANDARD GRADES ESTABLISHED)

For eating purposes, grapes should be allowed to become ripe. Dry, shrunken, cracked, or split, mildewed, undersized, or otherwise defective grapes should be trimmed out with a pair of blunt scissors or the entire cluster should be discarded. Only full, attractive clusters give satisfaction for table use.

If grapes are wanted for other than table use, the quality need not be quite so high, but only fairly well-filled clusters of good sound grapes should be shipped. Climax baskets, ordinarily used for commercial shipments of grapes, are not strong enough for long-distance parcel-post shipments, but the 6-basket carrier is satisfactory. For smaller quantities stave baskets may be used. As grapes settle considerably, the container should be carefully packed and well filled.

BERRIES

Berries should be picked only when dry; they should be removed from the sun, kept as cool as possible, and shipped promptly. They should not be held over from day to day. Defective and cull berries should be kept separate, as gathered, to avoid further handling, as rehandling is injurious to the carrying quality and therefore to the market quality of the berries.

Dewberries and blackberries (United States standard grades established).—Dewberries and blackberries should be picked when a full, bright black, but must not be allowed to become too ripe. All defective berries should be excluded. A container of suitable size, supplied with quart baskets, is most suitable.

Huckleberries and blueberries.—Huckleberries and blueberries can be shipped by parcel post with satisfactory results, but they are rather difficult to handle. They roll from the tops of the boxes and easily spill out of the crates.

The crates should be relatively tight, and yet they must afford ventilation. The quart baskets should be especially made for this purpose, with tight corners. The ventilation of the crates can best be provided at the top.

In picking, all trash, like leaves and twigs, and all defective berries must be kept out.

Raspberries.—As practically all varieties of raspberries are rather difficult to ship, special care must be taken that they be picked only when dry and while still firm, though ripe. They must be carefully handled, crated as picked, and never rehandled. Extra care must be taken to see that the boxes are well filled, because their cuplike shape gives them a tendency to settle in shipping. Containers supplied with pint or half-pint baskets are preferred.

Strawberries (United States standard grades established).—Strawberries should be picked when sufficiently ripe to reach the consumer in good condition. They should be picked with the hull or cap on, the stems being pinched short as possible. The berries should be placed in 1-quart baskets as picked and not held until a handful accumulates. This will avoid bruising. Small, inferior, lopsided, dirty, and overripe berries should be placed in separate baskets as picked, but not for market. The quality and size should be the same from top to bottom, and the baskets should be well filled. Topping or facing the baskets with larger fruit should not be done, but all stems of the top layer may be turned down so that the berries will be well shown. They should never be picked wet if it can be avoided.

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If the strawberry season happens to have unfavorable weather it may not be possible to make satisfactory parcel-post shipments.

Figure 3 shows a 32-quart crate of strawberries shipped by parcel post. The baskets should have been better filled, as the berries have settled so much that the baskets are no longer filled. There are also 12 and 16 quart and 16 and 24 pint-size crates that are suitable for strawberries.

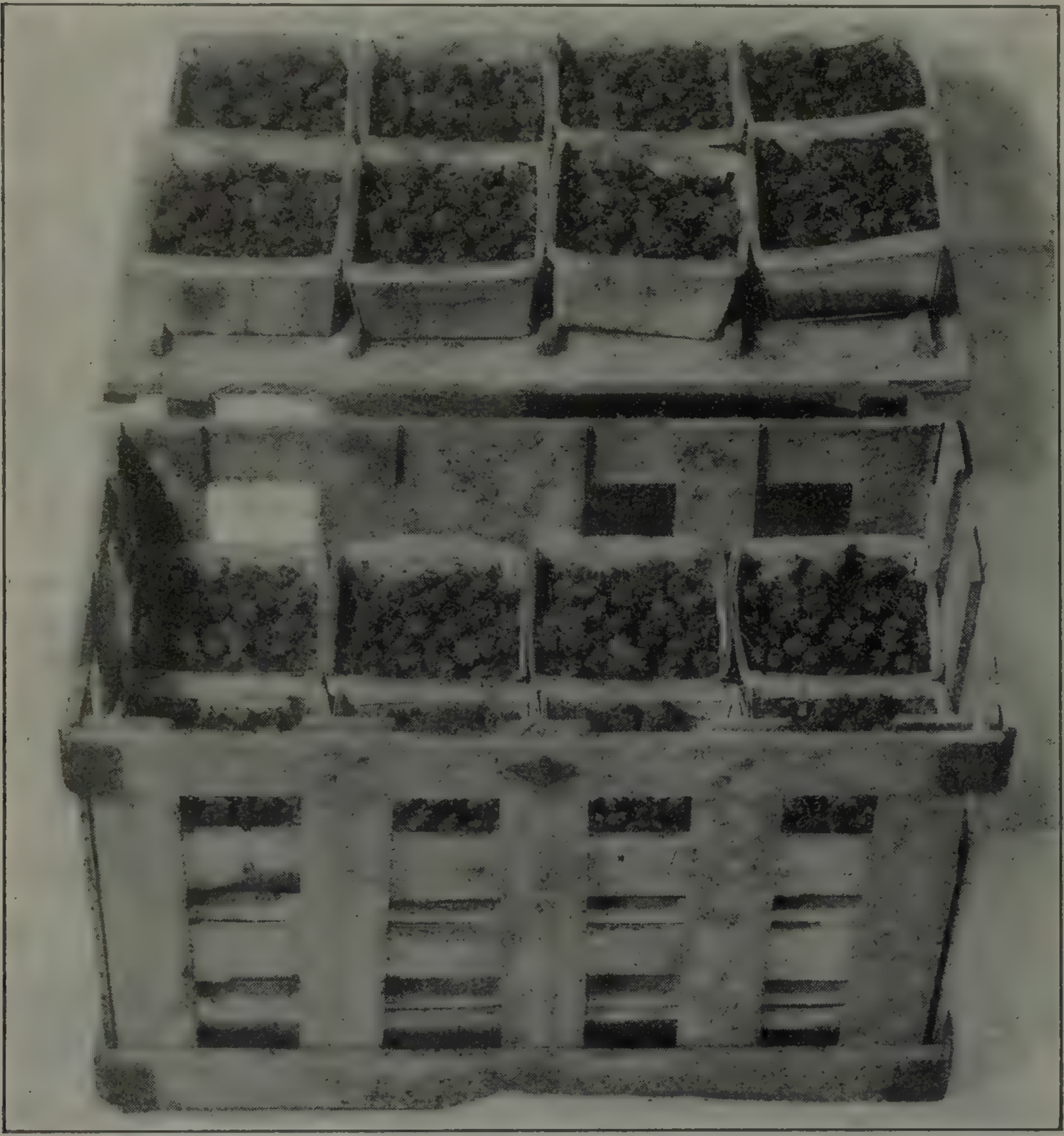

FIG. 3.—A 32-quart crate of strawberries shipped by parcel post. This style of crate is rather heavy for parcel-post use. Crates like those shown in Figure 2 are preferred by most consumers. The baskets should have been better filled

PEACHES (UNITED STATES STANDARD GRADES ESTABLISHED)

It is important that peaches be handled carefully to prevent bruising. For shipment by parcel post they should be "hard ripe"; that is, matured but showing no softening of the flesh by being full ripe. Varieties should not be mixed unless the customer asks for an assorted shipment. They should be smooth, properly colored for the variety, free from worms, split pits or seeds, bruises, disease, or other defects, and should be the proper size for the variety. They may be shipped either in 6-basket carriers or hampers. (Fig. 4.) Sometimes splint baskets are used. The 6-basket carrier of small jumble-packed fruit is practically unsalable. The 6-basket carrier packed in layers is attractive and draws attention. Peaches should be well and solidly packed to prevent bruising. The bushel basket, and for smaller quantities, stave baskets are satisfactory.

PEARS (UNITED STATES STANDARD GRADES ESTABLISHED)

Pears are picked in a matured state though green in color, because few varieties ripen satisfactorily on the tree. They should be picked when fully developed and when the stems will separate readily from the twig. They should be handled carefully, because they bruise and turn black easily. They should be free from worms, bruises, cuts, practically free from disease, specks, blemishes, etc.. and of proper size and shape for the variety. No fruit from the ground should be shipped. Figure 5 shows a crate of pears that were shipped when too ripe and without being properly packed. Round stave baskets or climax baskets will be found desirable as containers.

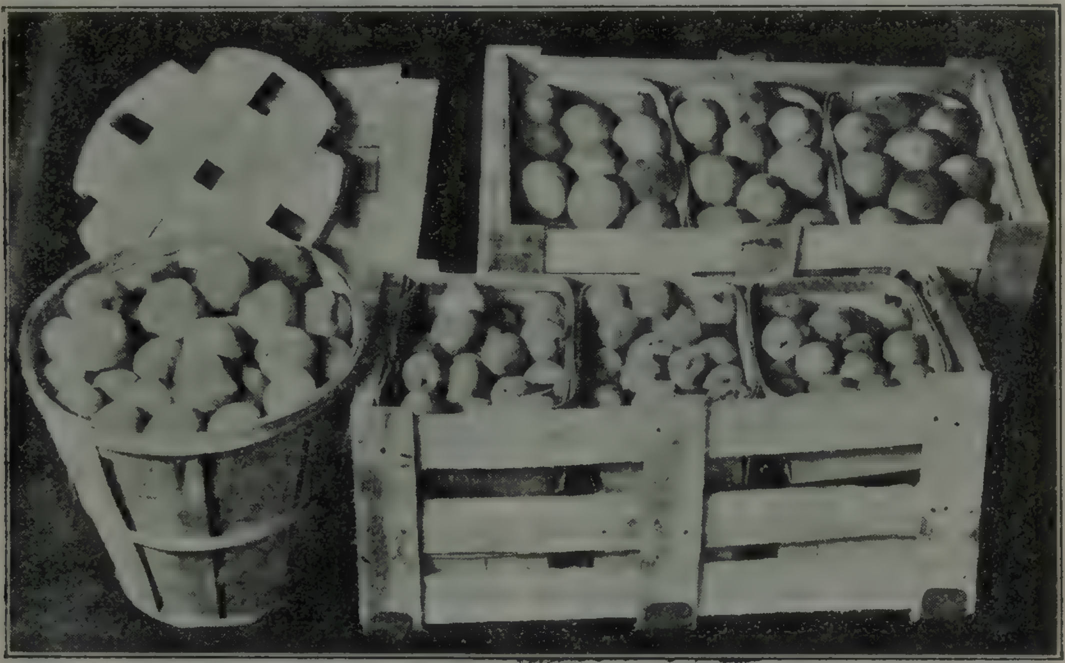

FIG. 4.—An experimental shipment of peaches in a "Delaware" basket and two "Georgia" or 6-basket carriers. Fruit well graded and packed, as in the upper 6-basket carrier, is much more attractive than the jumble pack of the other containers

PINEAPPLES (UNITED STATES STANDARD GRADES ESTABLISHED)

Pineapples should be harvested at the proper stage of maturity to reach the consumer in good, sound condition and when not overripe. The regulation commercial containers proved satisfactory in experimental shipments made by parcel post. Containers which are not sufficiently rigid to keep the pack well in place proved undesirable in tests, as they cause the fruit to bruise, although bruising may be prevented if packing material like excelsior is used. But because of the bulk, and therefore the weight of parcels of pineapples, the economy of marketing them by parcel post is relatively limited.

PLUMS, DAMSONS, AND FRESH PRUNES (UNITED STATES STANDARD GRADES ESTABLISHED)

Plums, including damsons or preserving plums, and fresh prunes should be picked at such a degree of maturity or approaching ripeness that they will reach the consumer in good, sound, nearly ripe condition. Careful handling is needed to prevent decay in shipping. As these fruits do not ripen uniformly, care must be exercised to cull out the overripe fruit. Cracked, ill-shaped, off-colored, wormy, or otherwise defective fruit should be kept out. One soft plum will wet the plums which touch it and start decay in them. Crates supplied with 1-quart baskets, climax, and stave baskets prove satisfactory as containers.

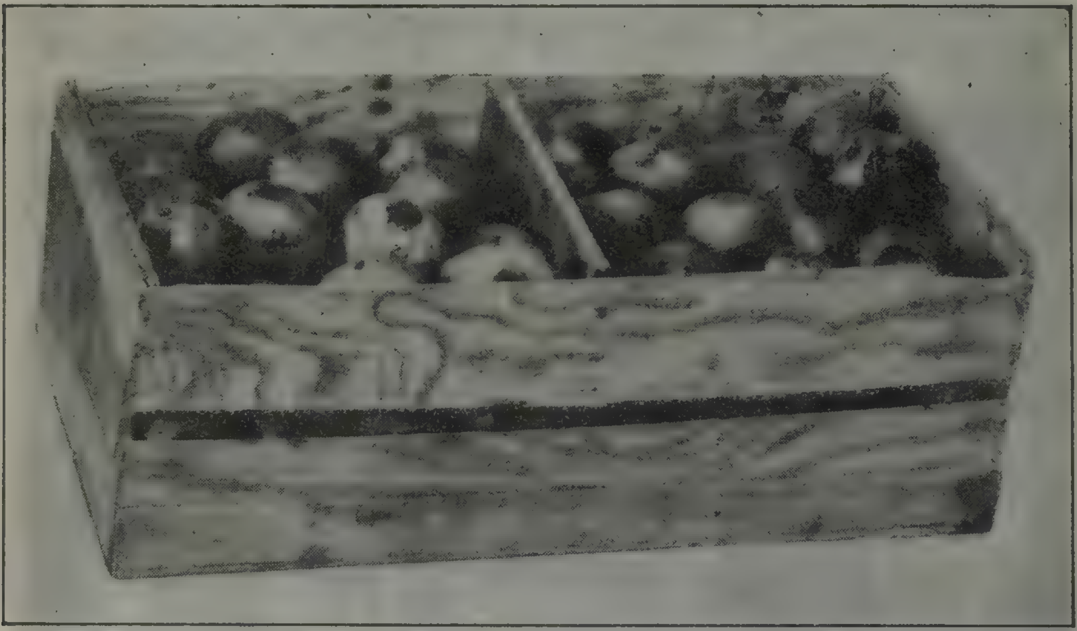

FIG. 5.—Pears which were too ripe when shipped and which were not properly packed were badly bruised and decayed at the journey's end

VEGETABLES

ARTICHOKES

Two vegetables are known by the name artichoke. The one is the Globe artichoke, of which the blossom head is the part used; the other is the Jerusalem artichoke, with underground edible tubers.

Jerusalem artichokes.—Jerusalem artichokes are little used in this country and present no particular problems in shipping by parcel post.

Globe artichokes (United States standard grades established).—Globe artichokes are considered a delicacy. They should be packed in a container that will give protection from bruising, yet give sufficient ventilation to prevent scald.

ASPARAGUS

The tender young shoots of asparagus should be cut often enough so that they do not become tough or overgrown. They should be cut when dry, should be carefully culled, and tied in one-half pound or pound bunches, with the tops even and the bottoms cut off. (Fig. 6.) Wrapping in parchment or similar paper improves the appearance. Asparagus loses quality according to the length of time between gathering and cooking. The usual commercial container, which is a crate made narrower at the top than at the bottom, to suit the shape of the bunches, can be used in parcel post, but if smaller quantities than a small crate are wanted by the customer, any suitable container that affords protection and ventilation may be used. If the ends of the asparagus are set in a layer of damp moss, drying out will be largely prevented.

BEANS

Snap beans, green or wax (United States standard grades established).—Snap beans, whether bush or pole variety, or whether green or wax color, should be picked when free from rain or dew, when tender, when crisp enough to snap, and before the seed is large enough to bulge the pod very much, although a few varieties are desirable even after distinct bulging of the pod has occurred. Any defective, rusty, insect-eaten, discolored, or undesirable beans should be sorted out. The beans should always be fresh-picked when shipped. Varieties which have little if any string are always preferred by customers. Any available container that will carry beans properly and keep them fresh with ventilation will serve the purpose. A splint basket makes a good container for beans.

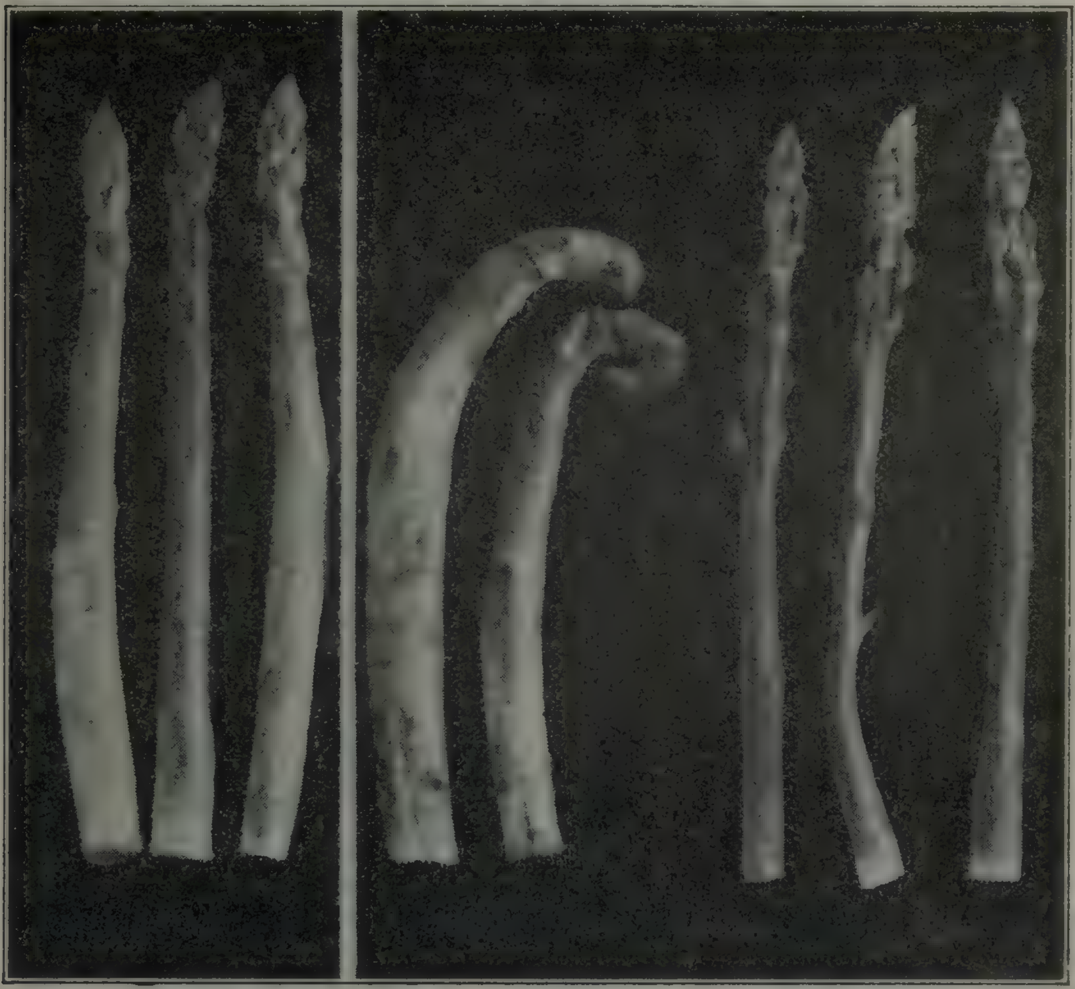

FIG. 6.—Satisfactory (three to left) and unsatisfactory (five to right) stalks of asparagus

Lima beans.—Lima beans should be gathered when dry and may be shipped either in the pods or shelled. When in pods, a box, basket, or crate can be used as a container. Only good, clean, full pods should be shipped.

Shelled Lima beans should be shipped as soon as possible after being picked and shelled, as they heat easily and soon become spoiled. A splint basket or a container supplied with the ordinary 1-quart berry baskets make a suitable container. As Lima beans shrink noticeably both in size and weight after they are shelled, the producer should allow for the shrinkage and should be sure to ship a full measure. The customer should be told that immediately on receipt of the shipment the beans should be spread out on a table top or suitable place and allowed to cool. Although Lima beans may be kept several days in a refrigerator or other cool place they are likely to become discolored and tough and to lose quality.

Dry or shell beans.—Dry or shell beans are not perishable, as are fresh vegetables, and they can be shipped satisfactorily in a bag of any kind of material that is sufficiently strong. If included in miscellaneous shipments, a bag which is less strong may serve the purpose. They should be clean, of practically uniform size, free from disease and insect injury, discolorations, or other defects.

Either ripe or dried Lima beans can be as readily shipped as can dried beans of other kinds.

CABBAGE (UNITED STATES STANDARD GRADES ESTABLISHED)

A producer who wishes to market cabbage direct to the consumer should select a variety that produces firm heads that are small to medium sized, of good, tender quality. The heads should be carefully trimmed of waste leaves and the stalks should be cut close to the head; soft, bursting, or decaying heads must be excluded. Because of the weight of cabbage in comparison to its value, direct marketing will not be found feasible, but in shipping of miscellaneous vegetables the cost may be justified.

CANTALOUPES, PROPERLY NAMED MUSKMELONS (UNITED STATES STANDARD GRADES ESTABLISHED)

To be satisfactory cantaloupes must first of all be of a variety of good quality. As cantaloupes cross-pollenize very readily, care must be taken in producing seed, or a trustworthy seedsman must be patronized. Cantaloupes do not cross-pollenize with pumpkins, squashes, cucumbers, and gourds, as is commonly believed. They should be pulled from the vines when fully netted and when they will nearly part from the vine clean, giving "a half slip," tearing the flesh of the melons a little. This will require care, as melons tend to ripen rapidly under hot-weather conditions. The melons must be firm to reach the consumer without becoming soft or mushy.

Cantaloupes require careful handling, because every bruise lessens the value and attractiveness. No bruised, overripe, matured, poorly netted, or otherwise defective cantaloupes should be included. Cantaloupes should preferably be packed in crates that will hold a given number of the size to be shipped. They can also be shipped successfully in climax or splint baskets if handled properly in transit. A little packing material may be used to prevent bruises in shipping. The melons should be picked in the morning and should be kept in a cool place until shipped.

CAULIFLOWER AND BROCCOLI (UNITED STATES STANDARD GRADES ESTABLISHED)

The heads of cauliflower and broccoli should be carefully handled when cut from the stalk and at every later stage. In trimming, preparatory to packing, at least one circle of the larger outer leaf stems, besides the smaller ones beneath these, should be left to protect the head. The tops of the leaves should be cut off even with the head. Inferior, discolored, diseased, or insect-damaged, or overgrown, or ricy heads, or heads otherwise defective should not be marketed. They should be packed and shipped promptly after gathering. Paper is sometimes placed over each head and tucked down inside the leaf stems for additional protection. The consumer should be informed that cauliflower should be used as soon after receipt as convenient. Besides being included in miscellaneous assortments of vegetables, cauliflower can be shipped in baskets, boxes, or crates.

CELERY (UNITED STATES STANDARD GRADES ESTABLISHED)

Only firm, fresh, well-bleached, clean celery should be shipped. After gathering, it should be washed and well trimmed of rootlets and loose and discolored leaves and stems. The stalks in each shipment should be of proper length and practically uniform in size, and most consumers prefer celery that has been bleached white. The producer should select a variety which bleaches or blanches readily. The stalk should be freed of water as thoroughly as possible by taking hold of each stalk by the base and giving it a swinging jerk to dislodge water from among the stems. The celery may then be wrapped in paper and packed in a basket, crate, or other container which will allow some ventilation but not enough to cause excessive evaporation and wilting.

In quoting prices on celery care must be taken to state whether the quotation is by the single stalk or by the bunch, if tied in bunches of more than one stalk.

CORN

Green sugar corn (United States standard grades established).—As the sugar content of sugar corn begins to change to starch soon after the ear is pulled from the growing stalk, sugar corn should be packed and shipped as soon as possible after it is gathered. It should be gathered at the stage of growth or development known as "in full milk," but before showing any signs of denting or toughness. Varieties that do well in the producer's section and that produce a high quality of product should be grown. All ears marketed should be well filled and well developed and practically free from worms and worm injury or other defects. The ears should be shipped with the husks on in a container that will prevent bruising and will afford some ventilation. In shipping sugar corn farmers should be sure they do not violate the quarantine against European corn borer, Japanese beetle, etc.

Dried sugar corn.—Dried sugar corn can be used in the winter when corn is out of season. Producers who can grow good sugar corn and who will give proper attention to drying it have developed a satisfactory business in marketing it direct to the consumer. Only good, bright-colored, dried corn should be shipped. Sweet corn, if dried too quickly, becomes too dark to market, and should be dried only when in the best eating condition as green corn.

Pop corn.—Pop corn can be shipped satisfactorily in almost any container. It may be shipped either on cob or shelled. Shelled pop corn costs less to ship than an equal amount of corn on the cob. It should be of a good popping variety and fully ripened on the standing stalk before frost. It should then be stored in a well-ventilated place until thoroughly dried. Only sound, clean corn is acceptable. Farm boys and girls may develop a business in selling pop corn in either popped or unpopped state.

CUCUMBERS (UNITED STATES STANDARD GRADES ESTABLISHED FOR SLICING CUCUMBERS)

Cucumbers may be marketed direct to the consumer either for slicing fresh or for pickling. For slicing a variety should be selected which produces long, straight, smooth cucumbers from 6 to 9 inches in length. The cucumbers should be cut and not pulled from the vine. Spongy, crooked, thick and short, yellow, runty, and overlarge cucumbers and those showing signs of ripening or those having wilted, shrunken, or undeveloped ends should be culled out. (Fig. 7.)

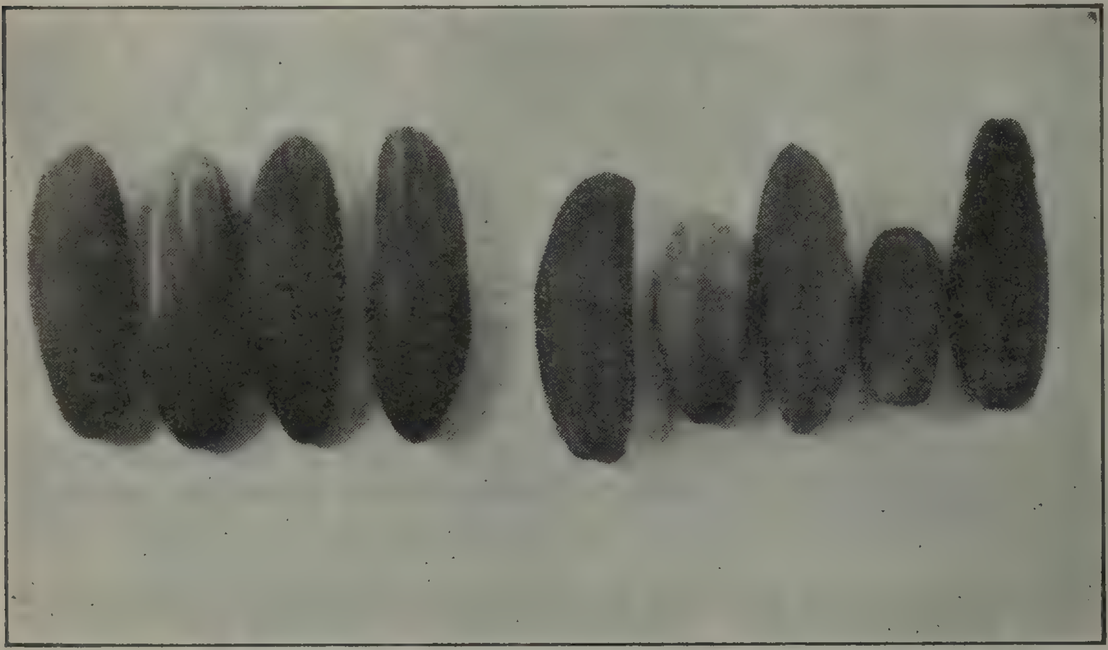

FIG. 7.—Four cucumbers on the left practically uniform in size, shape, and coloring. These are much more attractive and salable than the five irregular and defective specimens (culls) shown on the right

For pickling a good variety for the purpose should be grown and the cucumbers should be of the size wanted by the customer; usually those from 1 to 4 inches in length are wanted.

EGGPLANT

Eggplant should be cut when the fruits are of proper size and development and before they become tough. Fruits defective from any cause will not be satisfactory. The fruits should be handled carefully, wrapped in paper, and carefully packed. Excelsior or crumpled paper may be used for packing material when necessary to protect the fruit.

KALE

Kale should be fresh, free from sand, dirt, insects, and insect injury, and should be of good green color, without decayed leaves or stalks shooting seed tops, and of proper size according to the season. Kale carries satisfactorily by parcel post when packed in baskets, crates, or boxes, but it must have ventilation if it is to be more than 24 hours in transit. If not supplied with ventilation it begins to turn yellow rather quickly and loses its edible quality very rapidly.

LETTUCE (UNITED STATES STANDARD GRADES ESTABLISHED)

Lettuce for marketing is of two kinds—head and loose leaf. The head varieties are preferred by many people, though the loose-leaf varieties are much used in some parts of the country. A variety or varieties should be produced which yield satisfactorily both in quality and quantity. Head lettuce should be well developed, and the inner leaves should be white or nearly so before cutting. Lettuce should be free from dirt; no discolored, insect-damaged, diseased, or imperfect heads should be shipped. Loose-leaf lettuce should be cut when of considerable size but tender and crisp, and the old outer leaves should be trimmed off. Lettuce should be dry when packed.

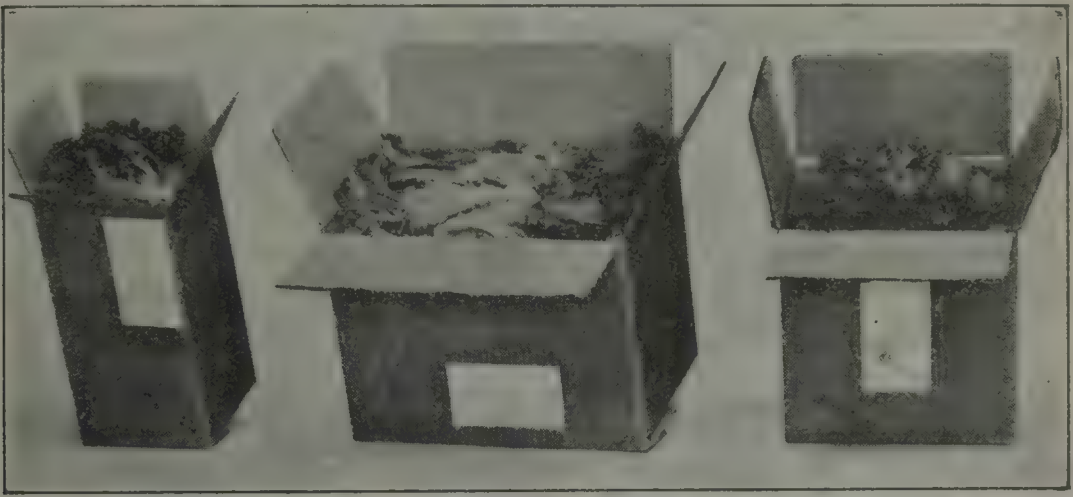

FIG. 8.—Lettuce, loose-leaf type, shipped in corrugated paperboard containers, which carry it satisfactorily

Almost any kind of container will serve for lettuce. If properly gathered and shipped dry, with instructions to the customer that it should be put in cold water on receipt, to replace evaporated water content and freshen it, it may be shipped long distances. Figure 8 shows loose-leaf lettuce shipped in corrugated paperboard containers. Lining the container with parchment paper improves the carrying possibilities.

ONIONS

Onions, green spring.—Onions should be pulled before they are too old or tough to prove satisfactory; they should be properly cleaned and trimmed and tied in bunches, with the tops left on or trimmed off as the customer wishes. Any suitable container may be used that will keep them clean and free from bruising. If green, though well-grown bulb onions are wanted, they may be prepared by cleaning and cutting off the roots and tops.

Onions, dry (United States standard grades established for Bermuda, northern grown, and creole onions).—All dry onions should be ripe, well cured, dry, and free from rot, disease, and insect injury, and clean. Onions of practically uniform size and shape give better satisfaction than irregular ones. No sprouted or frozen bulbs should be included.

PEAS, FRESH OR GREEN (UNITED STATES STANDARD GRADES ESTABLISHED)

Peas should be picked at a proper state of development and should be shipped in the pod. They should be gathered when dry; colored pods or any pods which are hard ripe or beyond a proper state of tenderness, or are poorly filled, diseased, insect-injured, or otherwise defective or dirty should be kept out. A basket, crate, or hamper which allows ventilation is the most satisfactory container for peas. If not allowed ventilation, the peas are likely to heat and mold.

PEPPERS

Peppers, sweet (United States standard grades established).—Peppers should be well grown and of uniform size and color. No wilted, cracked, or dirty, diseased fruit should be included. They should be crisp when shipped and be so packed that the fruits will not be crushed, cracked, or split. Most users of sweet peppers want a variety which has outer walls of relatively thick flesh.

Peppers, hot.—Hot peppers may be supplied according to the wishes of the customer. If the producer saves his own supply of pepper seed it must be kept in mind that if both hot and sweet peppers are grown in the same garden or truck patch they will cross-pollonize, and many peppers on the sweet plants will be more or less hot.

POTATOES (UNITED STATES STANDARD GRADES ESTABLISHED)

Occasionally it may be found profitable to market potatoes by parcel post. They should be of a good table variety; they should be clean, smooth, sound, and of good grade generally. Those affected with sunburn, disease, second growth, and bruises should be culled out. Potatoes less than 2 inches in diameter should not be shipped; the size should be fairly uniform.

New potatoes especially may at times be economically included in assorted parcels of vegetables. When shipped loose the container may be a bag, box, crate, or basket; but if shipped in a bag they are likely to be bruised and injured, unless the distance be short. Potatoes are perishable and should be handled accordingly. Occasionally a consumer may want small potatoes for such purposes as making salad. These can be supplied at a somewhat lower price than larger ones.

PUMPKINS AND WINTER SQUASHES

Pumpkins and winter squashes are heavy in weight in comparison with their value and usually can not be economically shipped direct, but at times the price returns may make it feasible to market them by parcel post. They should be of good quality and in good condition. The producer should endeavor to supply the variety, size, shape, and color wanted by the customers. Any available container which will prevent bruising and yet carry well will serve the purpose. Small-sized pumpkins and squashes can conveniently be included in assorted shipments.

SPINACH (UNITED STATES STANDARD GRADES ESTABLISHED)

Spinach should be of good green color, free from yellow or decayed leaves, crisp, free from insect injury, and of proper size according to the season and the market requirements. If necessary, should be thoroughly washed to free it from earth and sand. Unwashed spinach ships better than washed.

A plant called New Zealand spinach (not a true spinach) produces freely and continuously throughout the hot weather of the summer until killed by frost. For summer greens it has been found desirable.

SQUASH, SUMMER

Summer squash should be of the kind and degree of maturity wanted by the customer. Diseased, insect-injured, poorly developed squash should be excluded. A little packing material prevents bruises.

RHUBARB

Rhubarb, which is in season in the late winter and spring, and which may be produced in a cellar or other indoor place if properly handled, should be of as good size as possible and should be pulled before it becomes tough or strong. It is usually tied in bunches of three to six stems. Leaves should be removed before direct marketing, and only fresh, clean, well-developed stalks or stems should be shipped. A basket, crate, or box which allows some ventilation should be used.

ROOT VEGETABLES (UNITED STATES STANDARD GRADES ESTABLISHED FOR BUNCHED BEETS, CARROTS, RADISHES, AND TURNIPS)

Root vegetables may be divided into bunched vegetables and matured or main crop. Beets, carrots, radishes, salsify, and turnips when grown as early crops are frequently tied in bunches. This is desirable for two reasons: First, to keep the roots as nearly fresh as possible until used, and second, some consumers use the tops either as greens or for cooking with the vegetables themselves, as beets. Root vegetables with the tops left on will frequently pack more readily if not tied in bunches. When the consumer is satisfied to have the tops removed the shipment can be made more economically. The new or early root vegetables should be marketed when large enough, but still in tender condition. The mistake should not be made of shipping old, overgrown roots of early varieties of root crops, as they will not give satisfaction.

Main crop or matured root vegetables are usually firmer than early crop root vegetables and can have the tops cut off entirely. All root vegetables should be properly developed, tender, fresh, sound, and clean, with overgrown, oversized, or those with hard stringy cores sorted out. A bucket, basket, or crate is satisfactory as a container for root vegetables.

SWEET POTATOES (UNITED STATES STANDARD GRADES ESTABLISHED)

Sweet potatoes should be of good shape and color for the variety; they should be clean, sound, and bright, and those which are small should be discarded. Many persons like sweet potatoes of medium and fairly uniform size. They must be handled carefully, as bruises and cuts not only cause poor appearance but are likely to start decay. Chilling should be prevented.

Sweet potatoes are of two types: The one is dry and mealy, the other is moist and sweet. The producer should grow the kind wanted by his customer, and they should be well matured and properly cured. (The curing and storing of sweet potatoes is treated in Farmers' Bulletin 1442.[1]) Sweet potatoes can easily be included in assorted shipments. If sweet potatoes are shipped alone, a container should be used that will protect them from bruises and, in cold weather, from the cold. A bag is not suitable.

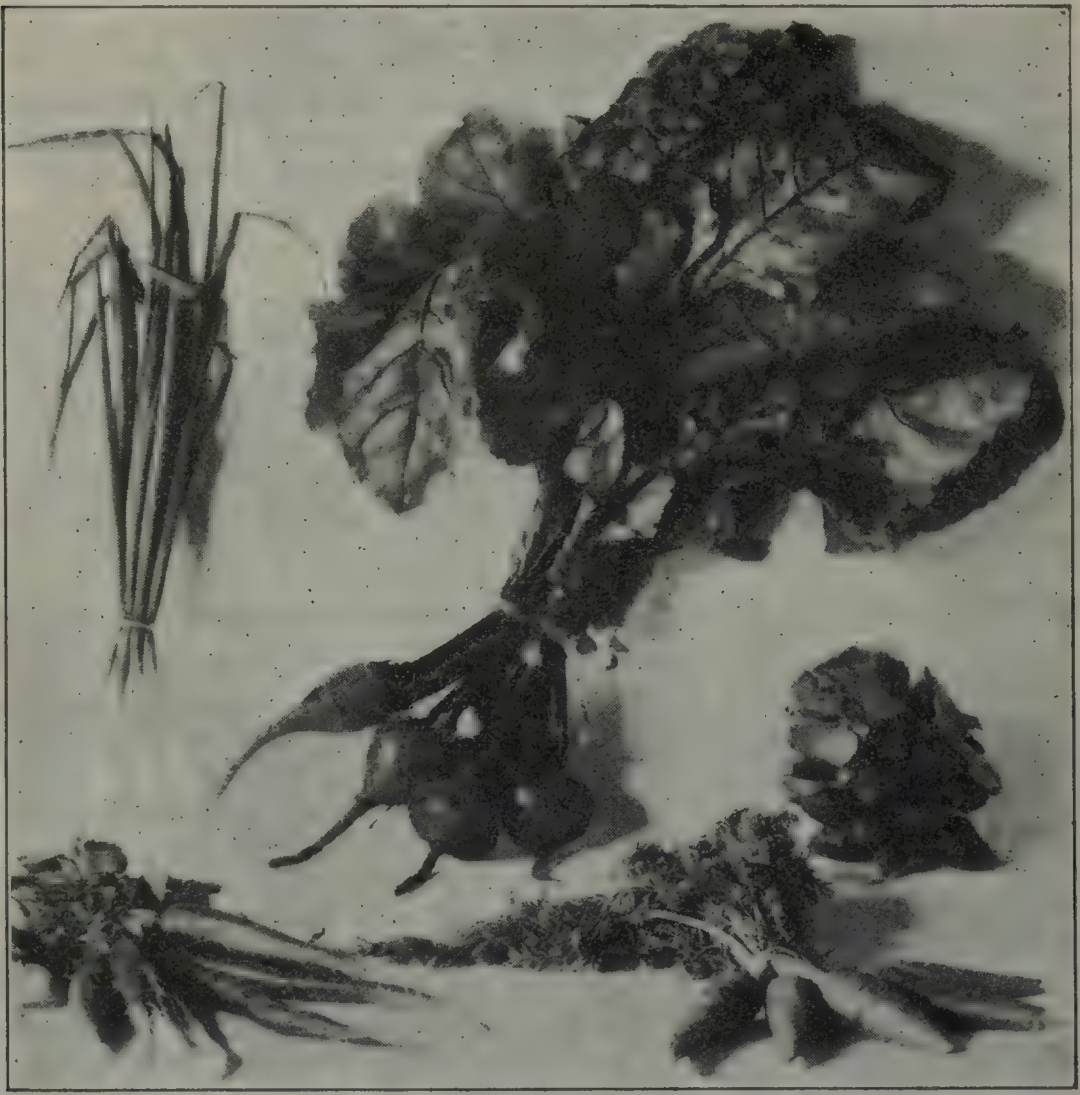

FIG. 9.—"Bunched" vegetables. From left to right: Long radishes, onions, beets, carrots, and round radishes

TOMATOES (UNITED STATES STANDARD GRADES ESTABLISHED)

Considerable care must be taken in picking, handling, and packing tomatoes to prevent their being bruised, cracked, or mashed. The stems should be removed. If for immediate use, the tomatoes may be practically ripe, but must be sound and firm. If the customer wants a supply for several days or a week, the tomatoes may be picked in the various stages of ripening, so as to ripen according to the customer's needs. No ill-shaped, split, wormy, or otherwise defective tomatoes should be shipped for eating purposes. A fairly uniform size proves most satisfactory. Any basket or crate in which a good firm pack can be made will serve as a container. If shipped with other fruits or vegetables, tomatoes must be so packed as not to mash. Wrapping each tomato in soft paper improves the carrying possibilities.

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[1] THOMPSON, H. C. STORAGE OF SWEET POTATOES. U. S. Dept. Agr. Farmers' Bul. 1442, 22 p., illus. 1925.

POULTRY

The great bulk of poultry consumed in this country consists of young and old chickens. What is said here in regard to marketing poultry has particular reference to chickens but may be applied to other kinds of poultry.

Anyone who wishes to market chickens direct to the consumer must endeavor to supply what the consumer wants. Young dressed chickens include broilers, weighing from 1 to 2 pounds; friers, weighing from 2½ to 3½ pounds; and roasting chickens weighing from 4 to 8 pounds. The so-called meat breeds are usually considered much more satisfactory for table use than are the egg breeds. Some consumers prefer a yellow-skinned chicken, whereas one with white skin is preferred by others. Breeds with light-colored feathers usually present a better appearance, as dressed poultry, because of the absence of the dark stains that are left in the skin of dark-feathered fowls when picked.

FATTENING POULTRY

Poultry, whether broilers, friers, roasters, or old fowls, must be properly fattened and in good, tender condition to prove satisfactory. Chickens, young or old, having free range on the farm are generally not in prime condition for table use. Fattening is most successfully accomplished by confining poultry to coops in which not more than $\frac{6}{10}$ square feet of space is available for each young chicken and not more than 1⅕ square feet of space is available for each of those half grown or larger. Extensive study and experience show that soft feeds such as a mixture of ground grains, mixed with sour milk or buttermilk, produces much better flesh for table use than that produced by grain feeding. A fattening period of about 10 to 12 days is usually sufficient for young chickens; old ones (fowls) may be fattened in 5 to 7 days.

KILLING POULTRY

For 24 hours before chickens are killed they should have water to drink but should have no feed. Feed in the crop or intestines of a chicken when it is killed causes loss of flavor and hastens decay. Chickens may be killed either by cutting off the head or by hanging the chicken by its feet and then inserting a suitable narrow-bladed knife in the mouth and giving a diagonal cut just back of the bony part of the head to sever the main blood vessels in the neck. If this is done properly the chicken will bleed freely. For humane reasons, "braining" should be practiced.

Braining is done by thrusting the knife through the roof of the mouth, into the brain, until the point of the knife touches the skull; the knife should then be given a twist to cause paralysis.

There is a way of piercing the brain by inserting the knife under the eye.[2]

If the chicken is to be dry picked, braining causes the feathers to "let go" or pull easily.

If the chicken is killed by cutting the head off, the skin should be drawn back on the neck so that when the dressing is completed it can be tied over the end of the severed neck. Some customers may want poultry with the head on as they can then judge somewhat whether the fowl was healthy.

Good bleeding is necessary to the production of a first-class dressed carcass, and gives a much better appearance. Hanging up by both legs to keep the carcass in good shape is the best way to get a thorough drainage of blood.

DRESSING CHICKENS

A dressed chicken may have the feathers off or the feathers, head, and feet off. In these cases it is more properly described as partly dressed. Or it may have feathers, head, and feet off and be drawn in addition; that is, have the entrails taken out, which would make it fully dressed. Care is needed both to do a good job of the dressing of the fowl and to prevent bruises, broken bones, and scarred or broken skin or soft places in the flesh. Cleanliness in tools and materials used and in work is necessary.

Picking a chicken is accomplished by the scalding method or by dry picking. Some consumers are satisfied with scalded poultry, whereas others want it dry picked. Unless care is exercised, the scalding is likely actually to scald the skin. If this happens, the poultry is not likely to keep as well as dry-picked poultry, because the skin is more likely to be torn. Water just below the boiling point should be used, and the poultry should be scalded only enough to loosen the feathers. This produces a fairly acceptable carcass if done with care. The feet and head of the fowl should not be immersed in the scalding water; they should be washed in cool water after the fowl is picked. Head, legs, and feet should be thoroughly cleaned to give a good appearance.

Dry picking generally produces a more satisfactorily finished product.[3] Figure 10 shows a good dry-picked chicken and one with skin torn from scalding. Dry-picked poultry usually gives better satisfaction than scalded poultry, as it has a better appearance, is of better quality, and keeps longer.

Undrawn fowls may be shipped with head and feet on or removed, as customers request. If the head is removed, the neck skin should be drawn over the severed neck end and tied to keep the end of the neck from being exposed to the air. At the same time the neck can be tied back into place. Both neck and feet should be wrapped in tough wrapping paper and tied with cloth bands, as described later.

Some customers want chickens to be drawn. Although this is somewhat more economical in postage costs, drawing shortens the time of keeping in good condition. Removing the entrails of a chicken exposes the internal surface to the air and gives opportunity for decomposition to set in much more quickly than in an undrawn one. If full-dressed poultry is prepared for shipment by parcel post, the dressing must be done carefully and thoroughly. The walls of the abdominal cavity must be thoroughly washed out to remove all blood and refuse. The cavity should then be dried with a cloth on which a little salt has been sprinkled. The giblets should be washed, dried, salted, and tied in a cloth. They will not carry successfully if merely cleaned as for home cooking and placed loosely in the cavity of the fowl, for this may cause decay. In hot weather drawn poultry should not be shipped if it will be in transit any considerable length of time.

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[2] PENNINGTON, M. E., and BETTS, H. M. P. HOW TO KILL AND BLEED MARKET POULTRY. U. S. Dept. Agr., Bur. Chem. Circ. 61: 1–11, illus. 1915. (Revised ed.)

[3] UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF AGRICULTURAL ECONOMICS. HOW TO PICK CHICKENS. U. S. Dept. Agr. Misc. Circ. 42, 14 p., illus. 1925.

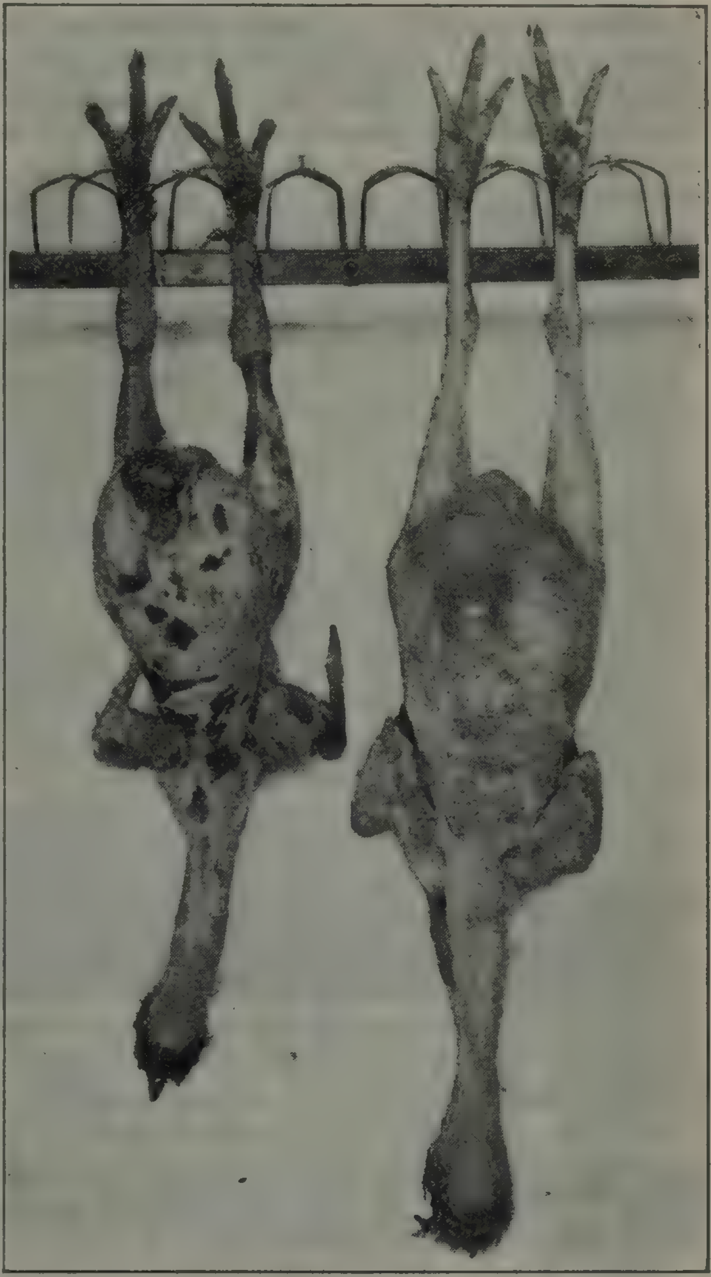

FIG. 10.—Comparison of scalded chicken (left) and dry-picked chicken (right)

SHRINKAGE IN DRESSING

Before marketing dressed poultry the producer should know the amount of shrinkage resulting from dressing. Practically every farmer knows what price he can get for live chickens or fowls. This, then, is the basis on which, if need be, prices may be decided. Loss in dressing varies greatly, as it depends on type or breed of fowl, condition, and age. The relative loss in dressing small chickens is greater than in dressing large ones. A well-fattened chicken loses less proportionately in dressing than a thin, unfattened one. Food in the crop or intestines also has a bearing on the shrinkage. It is not possible to state an average percentage of shrinkage to be expected because of the wide range of shrinkage caused by size, weight, type or breed, and condition. Experimental records and inquiries made of dealers and others show that loss of weight by bleeding and picking varies from 8 to 17 per cent, and in full dressing it varies from 20 to 40 per cent.

It is well worth while for each producer to determine for himself how much the shrinkage amounts to in dressing his own chickens. He should make a record of the live weight before killing, the weight after bleeding and picking, and then, if the fowl is fully dressed, a record of the weight after thoroughly cooled, chilled, and ready for packing and mailing.

CHILLING DRESSED POULTRY

Dressed poultry, to carry satisfactorily and reach the customer in good condition, must be cooled and, if possible, chilled before packing and mailing. In most of the country during the fall, winter, and spring, when the weather is cool or cold at least at night, the chilling of poultry is easily done. The ideal temperature ranges from 32° to 38° F.; the air should be dry. Such conditions, even in winter, do not always prevail. Care must be taken that a freezing temperature is not reached before the animal heat is thoroughly out of the carcass.

After the dressing has been completed the carcass should be shaped by drawing the thighs close to the body and tying them in place. Cloth bands are tied around the fowl and are kept there until the cooling and chilling is completed. A cord or string should not be used for tying, as it may cause a crease or may even bruise the flesh. The fowl should then be put into a clean dry place and kept there until the body heat has disappeared and the temperature of the body cavity of the fowl is the same as that of the external parts. An indoors temperature of 35° to 40° F., with a circulation of air, is satisfactory if the lower temperature is not available. A spring house or cold cellar may serve as a cooling place. If neither is available, hanging the dressed poultry down into a well, but keeping it dry in a covered vessel, may prove satisfactory if the shipping distance is not great nor the time in transit long.

Dry cooling or chilling is to be preferred, but if no other means are available immersing the dressed poultry in cold water may be resorted to. Care must be exercised to have the carcass cool through. Cooling in water should be done in as short a time as possible, to preserve flavor and quality, and the carcass should be thoroughly dried when the chilling is finished. Head and feet, if not removed, should be cleaned so as not to contaminate the chilling water.

Usually from 12 to 24 hours is required to cool thoroughly a dressed fowl; therefore it is best to cool a dressed fowl the day before it is to be mailed. But if satisfactory cooling facilities are available, cooling in the early morning and mailing in the evening give satisfactory results. In no case should poultry be packed and mailed with body heat yet remaining.

Many kinds of containers have been used successfully in shipping poultry by parcel post. Figure 11 shows a dressed chicken shipped during warm weather in May. The chicken had been properly chilled and was well packed by being wrapped in parchment paper, packed in excelsior, then inclosed in a jacket of corrugated paper board, and finally wrapped in good stout wrapping paper. Although the parcel was in the mails 48 hours, the chicken was in good condition.

Ready-made containers can be obtained, or they may be improvised from corrugated paper-board boxes, such as are readily obtained at many places without cost. Strict care must be observed that no odors of any kind are on the packing materials, especially on the corrugated paper-board boxes, as poultry readily absorbs odors and its value as food is greatly reduced or destroyed. Figure 12 shows an improvised box scored; that is, creased with a blunt knife, but not cut through. Figure 13 shows the box when packed, folded, tied, and ready for mailing. It is not necessary to improvise a box container if care is taken that at least two thicknesses of corrugated paper-board covers the parcel and that it is tied securely.

Splint baskets have been used with success. (Fig. 14.) If they are to be used more than once, they should be of the drop-handle style so as to nest one into the other; they can then be returned to the producer a number at a time in one package. Climax baskets have not proved satisfactory for poultry shipments, nor have shoe boxes or boxes of similar lightweight paper board, as they are not stout enough.

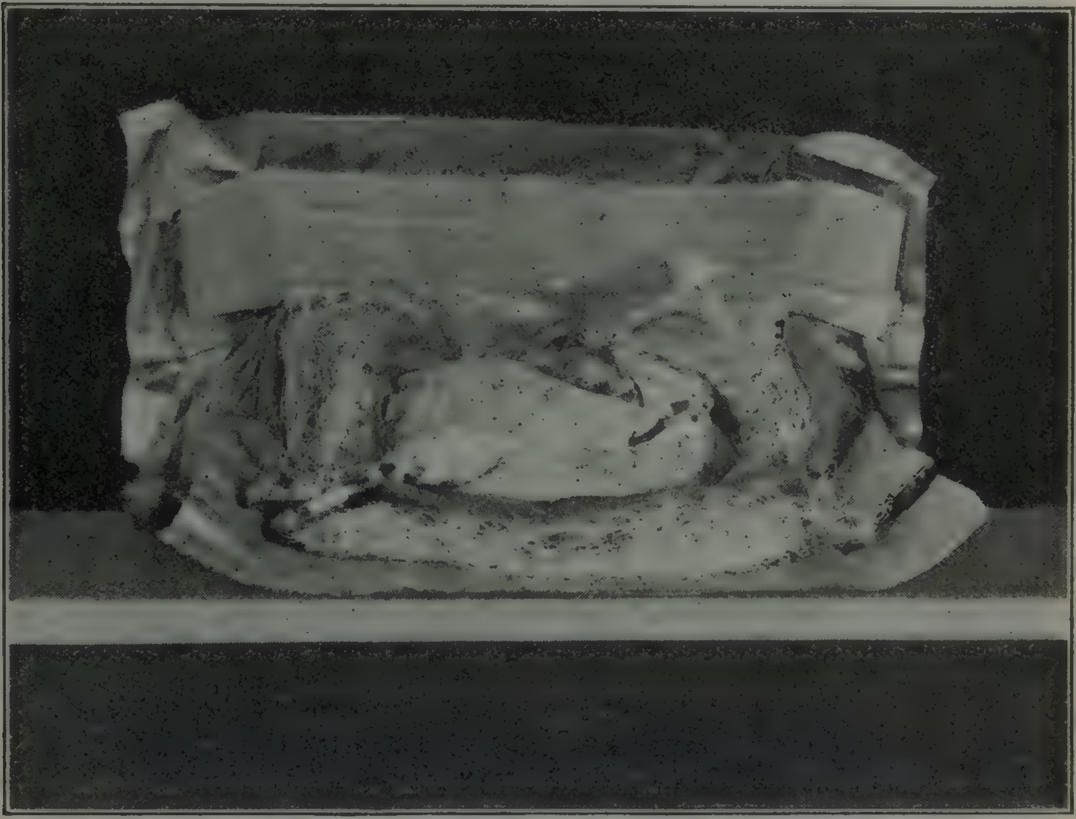

FIG. 11.—Dressed chicken received by parcel post during warm weather in May. As this fowl had been killed and packed properly, it was received in good condition, notwithstanding the fact that 48 hours had elapsed since the shipment was mailed. Parchment paper, excelsior, a piece of corrugated paperboard, and wrapping paper were used for a container

PACKING DRESSED CHICKENS

Packing should not be done until just before the time to mail. All the packing material and the containers should be cooled and the packing should be done in a cool room with a temperature of 40° F., or below if possible. Head and feet should be wrapped and the head turned back and placed against the bony part of the chicken. Clean wrapping paper next to the carcass, surrounded by additional wrapping of newspaper, is useful to keep out the heat. Vacant corners in the container or package should be filled out with crumpled newspaper or excelsior. Every care should be taken that the chicken

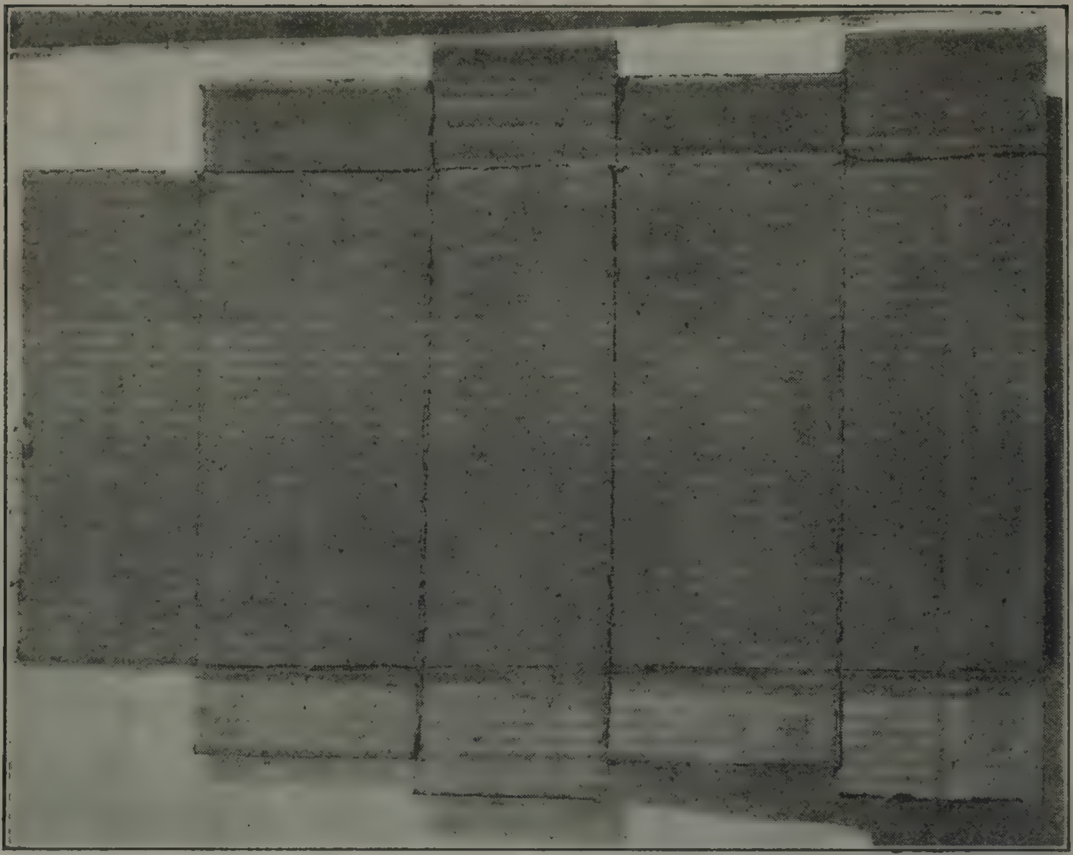

FIG. 12.—Piece of corrugated paperboard cut and scored to form a box 4 by 5 by 11 inches in size

may be in good shape and of good appearance on unpacking. The outer wrapping of every parcel should consist of good wrapping paper securely tied. If a splint basket is used, packing should proceed as already directed. At the end a pad of corrugated paper board, stout pasteboard, or thin, shaped wood should be placed on top of the contents and tied, as shown in Figure 14.

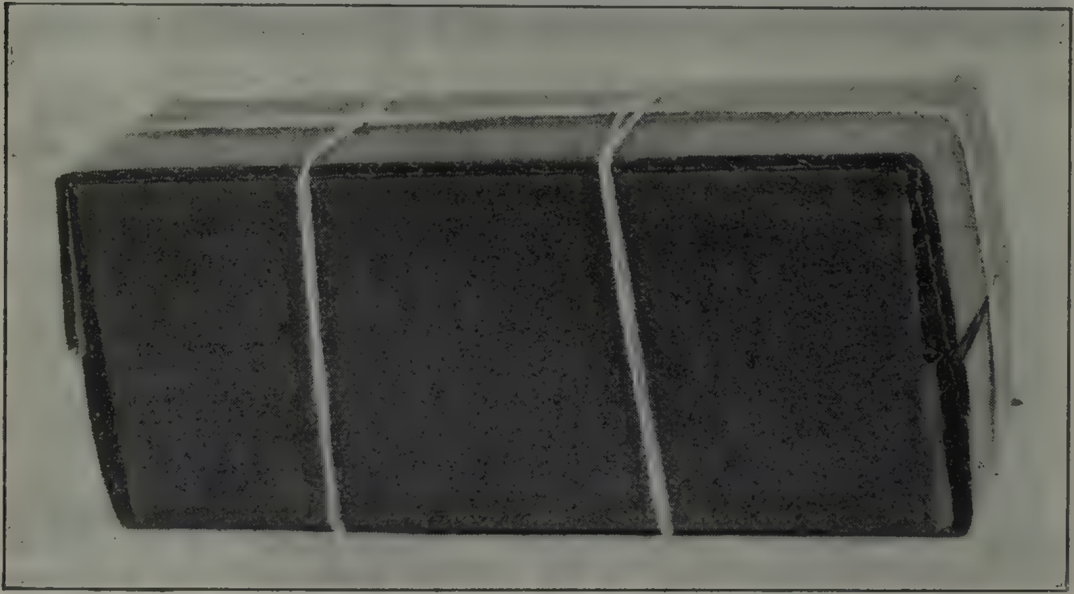

FIG. 13.—Piece of corrugated paperboard, as shown in Figure 12, folded to form a box and tied with twine

After it is packed, poultry should be kept in as cool a place as available and should be posted as near outgoing mail time as possible. It should be marked, "POULTRY, PERISHABLE," preferably in printed letters made by a rubber stamp or by hand. The customers should understand that poultry must be unpacked promptly on receipt and properly cared for.

EGGS

More parcels of eggs than of any other one product pass through the mails.

Many cities could be supplied with a considerable portion of their fresh-egg supply from within the first and second zones (and, when eggs are high priced, from the third zone) by parcel post. By such direct contact the producer should secure somewhat better prices for his eggs than are realized by other methods of marketing, and the consumer should obtain a fresher quality at no increased cost, or, perhaps at a reduction in price. The producer who does not have satisfactory marketing facilities may find in the parcel post a means of solving his egg-marketing problems, especially in the case of the man whose flock is so small that he can not make case shipments in the regular 30-dozen egg case.

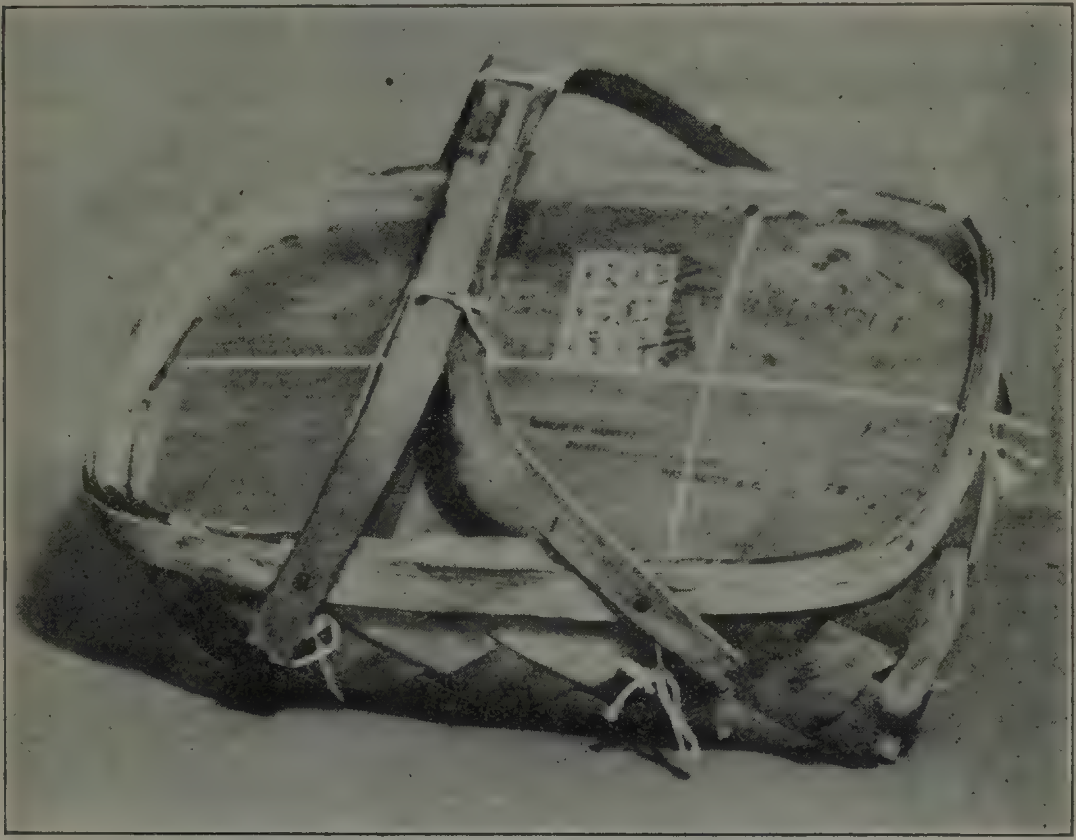

Fig. 14.—Shipment of dressed poultry in splint basket. The cover of corrugated paperboard is easily tied down, as twine can be drawn between the splints wherever needed

Only such eggs should be shipped as are produced by healthy fowls kept under proper sanitary conditions and supplied with sound, wholesome feed. If possible, only infertile eggs should be produced for market, as fertile eggs deteriorate rapidly and are the cause of much loss. A broody hen on the nest or exposure to a temperature from other sources sufficient to start incubation causes all such eggs to spoil.

Eggs should be cared for carefully. The fowls should be kept under such conditions that the eggs will not be soiled in the nest by mud from the feet of the hens or otherwise; the eggs should be gathered at least once a day (twice a day is better), and should be stored in a well-ventilated place, which must be kept as cool as possible. Eggs intended for high-class trade should never be washed, as washing removes the natural mucilaginous protective coating of the egg and opens the pores of the shell. Eggs which are soiled should never be sent to a parcel-post customer.

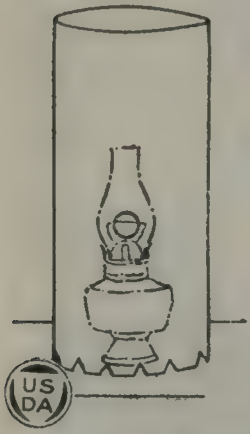

FIG. 15A.—A length of stovepipe and a lamp or electric light are easily converted into an egg candle. A hole 1¼ inches in diameter should be cut opposite the light

In spite of the greatest care it sometimes happens, under ordinary farm conditions, that an occasional bad egg appears among those sent to market. It is wise to candle every egg shipped; any defective ones should not be marketed. Candling is "the process of testing eggs by passing light through them, so as to reveal the condition of the contents." Homemade egg candlers may be easily and cheaply made by using any light that is strong enough for the purpose. An electric light is best, but a good kerosene lamp, gas, or sunlight may be used. One of the simplest and most satisfactory homemade devices consists of a length of stovepipe with an electric light or kerosene lamp set inside. A round hole 1¼ inches in diameter should be cut directly on a level with the light. (See fig. 15A.) A tin can having a removable top and large enough to take an incandescent lamp, with a 1¼-inch hole opposite the light filament, is another satisfactory homemade device where electric light is available. (See fig. 15B.) Such candling devices should be used in a darkened room. A simple device for use outdoors consists of a long heavy pasteboard tube like a mailing tube, large enough to admit the end of the egg. The eye is placed at the other end, and as the sunlight passes through the egg its condition is indicated.

Only first-class eggs can be marketed successfully by parcel post. The shipping of bad eggs causes dissatisfaction or even loss of customers, and in interstate shipments, if there are more than 5 per cent of bad eggs in a shipment, the Federal pure food law is violated. There is, however, no excuse for any bad eggs among those marketed.

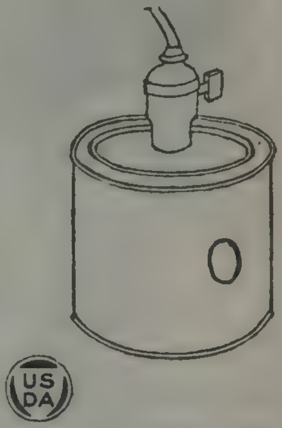

FIG. 15B.—An electric light and a tin can with removable top make a cheap and easily constructed egg candle. A hole 1¼ inches in diameter should be made opposite the light filament

EGG CONTAINERS

Experience has shown that parcels containing eggs are frequently mailed in containers not sufficiently strong and inadequately prepared and protected; these are a cause of complaint. The containers often can be secured more easily by the consumer, but the producer should make it a point to secure, through his local dealer or otherwise, such containers or carriers as meet the requirements of the postal authorities and will carry the particular product in a satisfactory way. Containers can be obtained from most farm-supply houses and from mail-order stores.

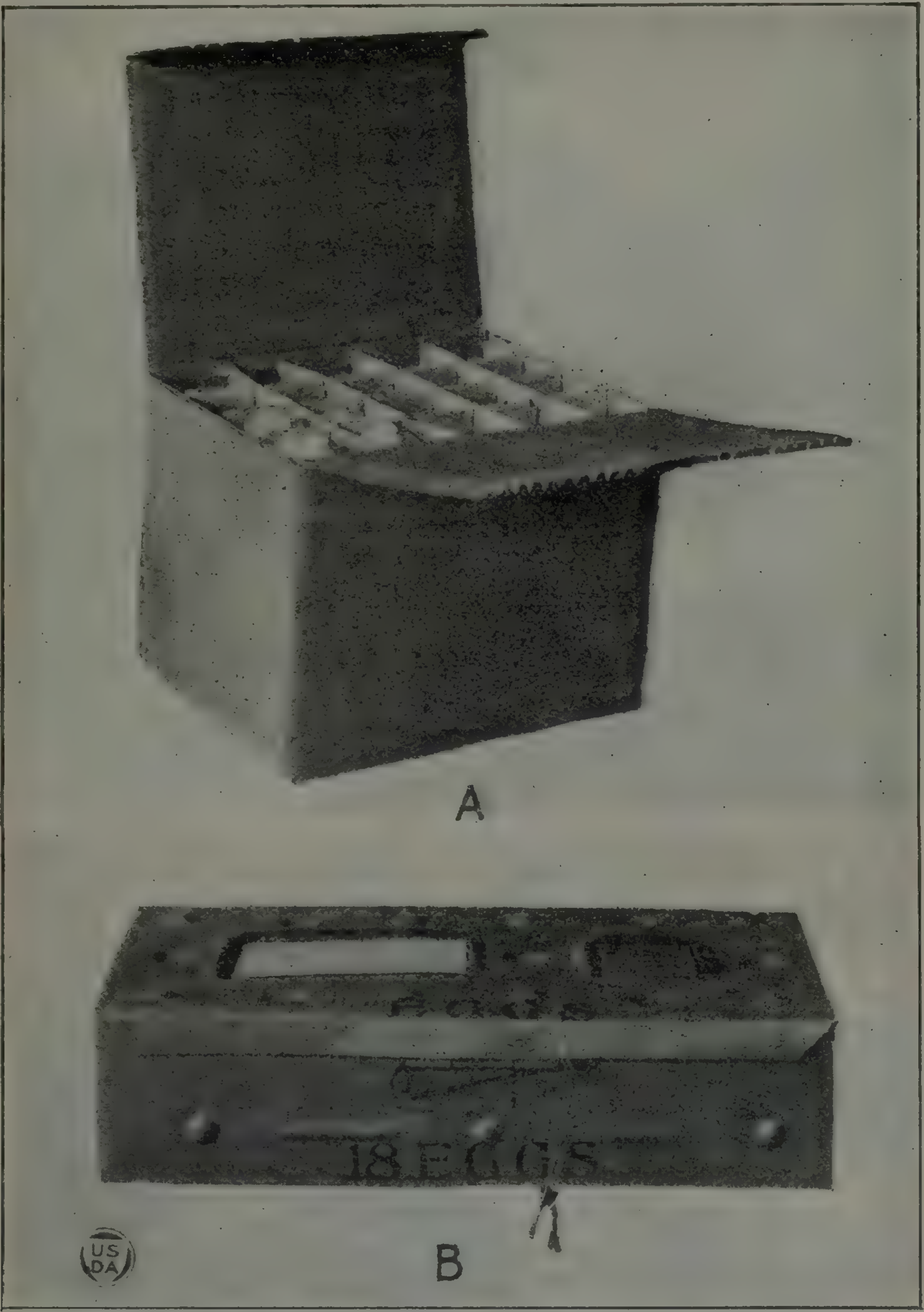

FIG. 16.—Shipment of eggs by parcel post requires strong, light containers. *A*, corrugated pasteboard container; *B*, metal container

The ideal container must be simple in construction, efficient in service, and cheap. Any part which is to be opened should be so marked or notched as to indicate the part to pull up or out.

Trials of many different styles and makes of containers or cartons for shipping eggs by parcel post have been made in experimental shipments. A number proved satisfactory in extended trials. (Fig.

16.) Any container which meets the postal requirements and which serves the purpose properly can be used.

The postal requirements for mailing eggs are as follows:

> Eggs shall be accepted for mailing when packed in crates, boxes, baskets, or other suitable containers, so constructed as properly to protect the contents; such packages to be transported outside of mail bags. All parcels containing eggs should be plainly marked "Eggs." When necessary, they should be marked "This side up."
>
> Eggs for hatching shall be accepted for mailing, when each egg is wrapped separately and surrounded with excelsior, wood wool, or other suitable material and packed in a basket, preferably with a handle, or other suitable container. Such parcels shall be labeled "Eggs for hatching," "Keep from heat and cold," "Please handle with care," or other suitable words, and shall be handled outside of mail sacks.

PACKING EGGS FOR SHIPMENT

If the trade requires it or if it can be done without any disadvantage the eggs for packing should be assorted as to size and color. Eggs irregular in shape, those which are unusually long or thin shelled or which have shells otherwise defective, should be kept by the producer for home use, so that breakage in transit may be reduced as much as possible.

Regardless of the style of the container, each egg should be wrapped with soft wrapping or newspaper, so that it will not shake about, and also to retard leakage if the egg be broken.

MEATS

Both fresh and cured meat can be successfully marketed by parcel post. The marketing of fresh meats in warm weather requires that very careful attention be given to chilling, packing, and mailing. Few farmers have facilities for cooling or chilling fresh meats, and so are not in position to market fresh meats except when the weather is normally cool or cold.

Fresh beef, if properly chilled and packed, can be sent considerable distances even in warm weather, provided it be again promptly chilled by the customer when it is received.

Fresh pork becomes tainted more readily than fresh beef and is therefore more difficult to ship satisfactorily by parcel post. Fresh pork sausage is usually much in demand by city dwellers and can be marketed by parcel post during several months of the year, even if refrigerating facilities are not available. If stuffed sausage or sausage inclosed in casings is dried for a few days or a week it will stand shipping much better. Sausage meat ground but not stuffed is more exposed to contamination and therefore to spoilage. Scrapple and pork products can be marketed by mail, but they require a good container. Retail butchers can market by parcel post even in warm weather if the meat is chilled thoroughly and packed properly with plenty of packing and wrapping paper to keep out the heat, provided the meat can be delivered to the customer within a few hours after mailing.

The opportunities for marketing cured meats are much greater than for marketing fresh meats, as cured meats can be sent through the mails during the entire year. Cured hams, shoulders, bacon, and smoked sausage can be sent by mail at a relatively low cost per pound, as they do not require an expensive shipping container; and such meats are in demand by consumers at all seasons. Figure 17 shows a

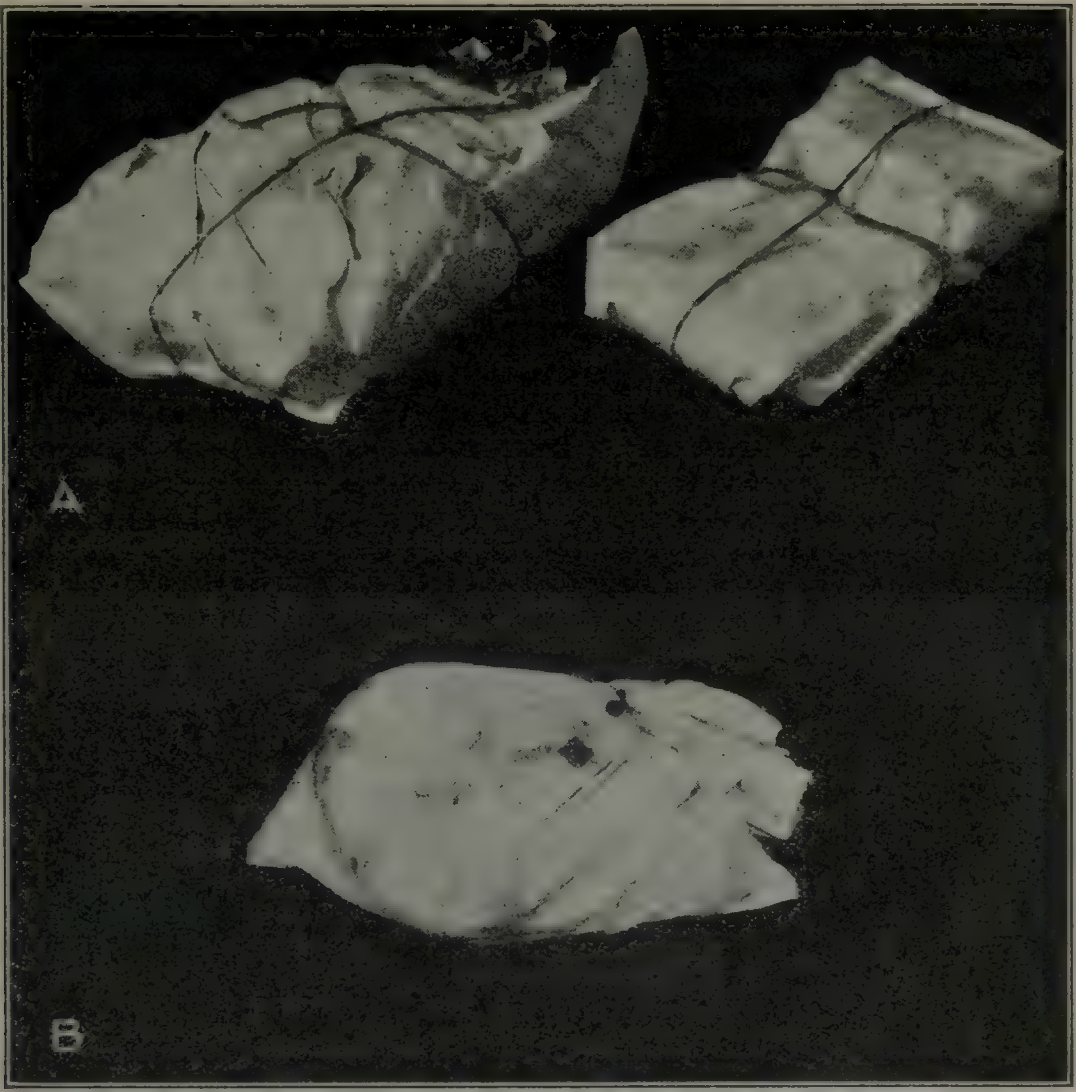

FIG. 17.—*A*, ham and side of bacon wrapped in paper and shipped in corrugated paperboard container; *B*, ham shipped in a strong bag

wrapped ham and a wrapped side of bacon and a ham in a bag that were shipped by parcel post. Figure 18 shows the appearance of the ham and the side of bacon when unwrapped.

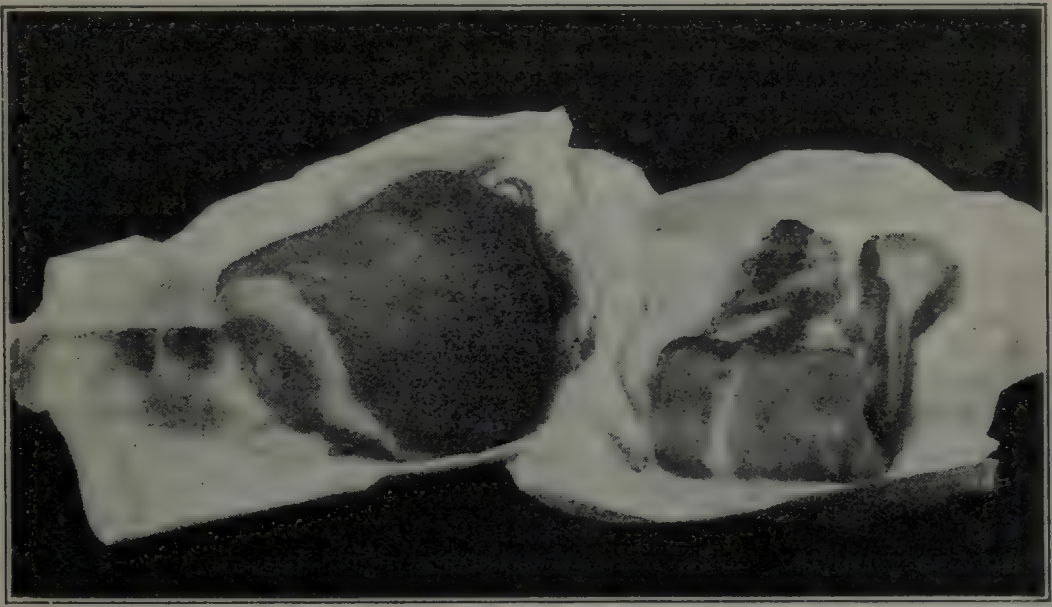

FIG. 18.—Ham and side of bacon shown in Figure 17, unwrapped

CURING MEATS

Particular care should be taken by farmers who cure meats for direct sale. Slaughtering should be done when the weather is cool. The carcass should be chilled thoroughly so that all of the animal heat is removed before the meat is cut up to be cured. A temperature of from 34° to 40° F. is desirable. It is better if the carcass is not allowed to freeze during the cooling process. The meat should not be placed where there are any disagreeable odors, as fresh meats take up odors readily. Cleanliness is very important for sanitary reasons and because meat becomes tainted very easily.

The curing of meat should begin while the meat is still fresh. It should be cut into uniform pieces and all ragged edges should be trimmed.[4] Whatever method of curing is used, care should be taken to keep the meat from taking up too much salt. After meats are cured and smoked they should be chilled to air temperature and wrapped in paper or cloth, to exclude dirt and flies, and should be stored in a dark room where there is ventilation to keep them in good condition until they are marketed. Success in marketing cured meats by parcel post depends to a large degree upon the proper curing of meat of high quality and keeping it in good condition until marketed. Figure 19 shows a piece of well-cured bacon which had been shipped flat and was received in good condition.

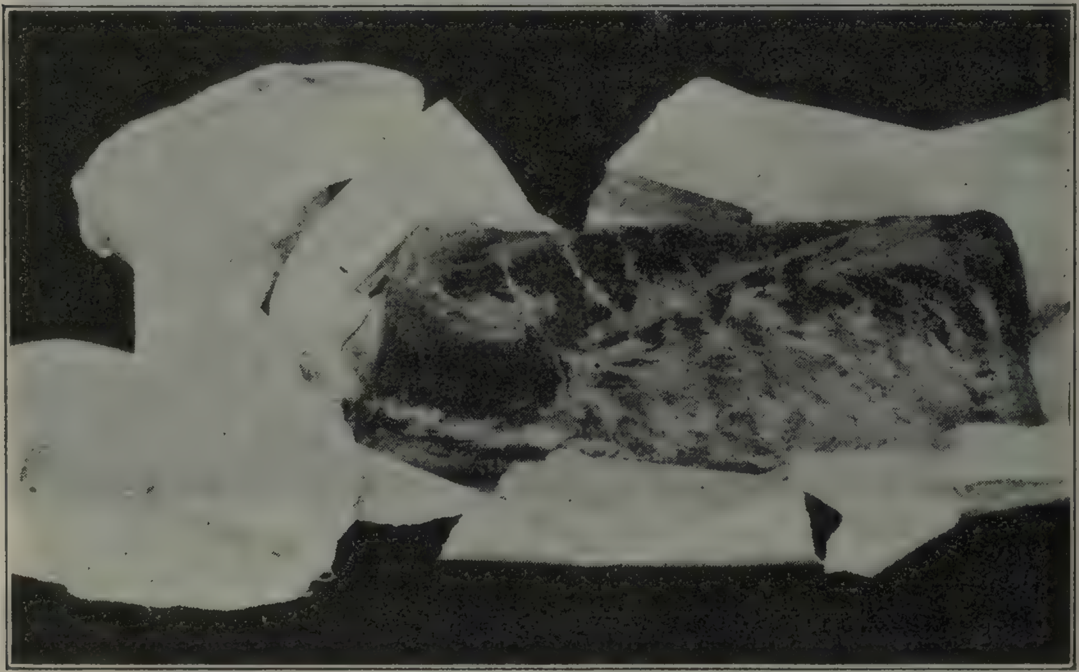

FIG. 19.—Side of bacon trimmed and cured properly. This meat was shipped, unrolled, by parcel post

CHILLING FRESH MEATS

If fresh meat is marketed by parcel post, it must be cooled before it is packed. It should not be shipped until at least 36 hours after the animal is slaughtered. It should be kept in a cool place and should not be packed until a short time before it is shipped. As in the case of poultry, care should be taken to prevent the meat from cooling too rapidly. The shipping containers and wrapping paper should be kept in a cool place until the meat is packed, as they will help in keeping the meat cool while it is in transit.

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[4] ASHBROOK, F. G., ANTHONY, G. A., and LUND, F. P. PORK ON THE FARM. KILLING, CURING, AND CANNING. U. S. Dept. Agr. Farmers' Bull. 1186, 44 p., illus. 1921.

Fresh meat received by parcel post should be unpacked and put in a cool place immediately upon arrival, or it will soon become tainted. Many city dwellers who have received fresh meat by parcel post and left it in a warm place for several hours thought that the meat was tainted because it was shipped by parcel post, but in many cases the damage to the meat occurred after it was received.

PACKING MEATS FOR PARCEL-POST SHIPMENT

In general, the instructions that have been given for packing poultry for shipment may be followed in packing fresh meats for shipment. Cured meats need only to be thoroughly wrapped to exclude dirt, flies, and other insects. Usually it is desirable to use a container. The meat should, of course, be wrapped in clean oil paper or waxed or parchment paper before it is tied up or packed for mailing.

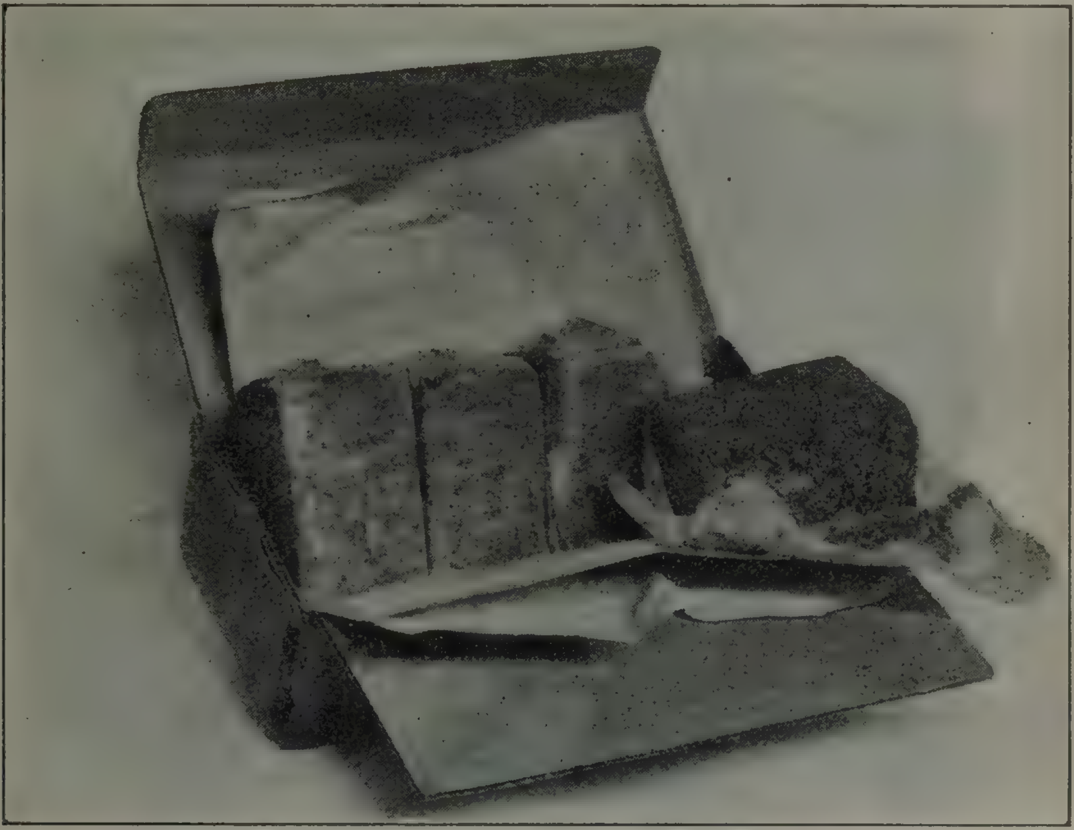

FIG. 20.—Four pounds of bulk sausage shipped by parcel post in corrugated paper-board container; each pound of sausage wrapped in parchment paper

Fresh meats require more careful packing for mailing than cured meats unless the weather is relatively cool and the time in shipment short. Fresh meats should be packed with sufficient packing material to keep out the heat. The meat, the packing and wrapping material, and the container should all be cold when the meat is packed for mailing. Corrugated paper board supplies satisfactory insulating material, keeping the cold in and the heat out. For sausage and similar meat products a container is desirable to keep it in good shape so that when delivered it will appear attractive. If bulk sausage is crushed in transit, the paper in which it is wrapped is usually difficult to remove from the sausage. Stuffed sausage can be sent without a container, but better results are obtained if containers are used. Figures 20 and 21 show actual shipments of sausage.

CERTIFICATES REQUIRED FOR INTERSTATE SHIPMENT

It is not necessary for a farmer to have Government inspection of meat from animals slaughtered by him on his farm. No certificate is necessary when shipping such meat to points in the same State unless in the course of shipment the article is taken through another State.

The regulations governing the meat inspection of the United States Department of Agriculture apply to any meat or meat product derived from the slaughter of cattle, sheep, swine, or goats to be shipped in interstate or foreign trade. Any farmer or person shipping meat slaughtered by a farmer on the farm, by parcel post, if it goes to or through any other State, must fill out and file with the postmaster two copies of the following form:

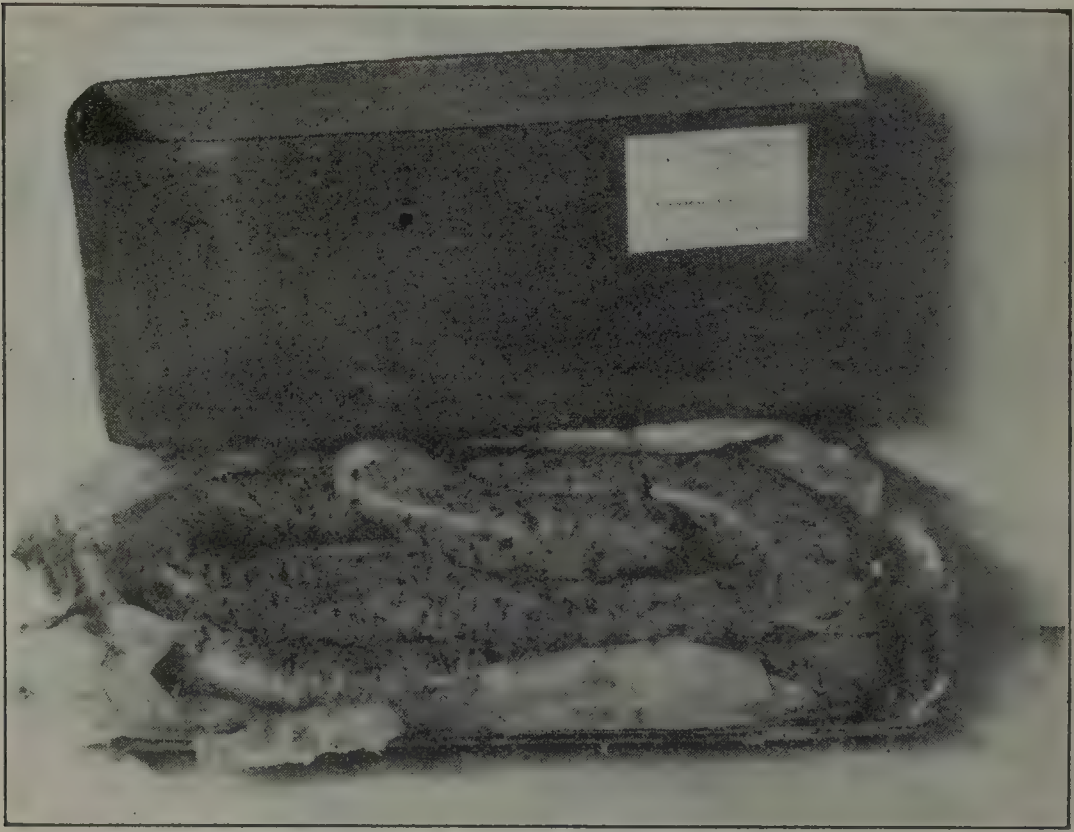

FIG. 21.—Parcel-post shipment of 5 pounds of sausage stuffed in casings. Container open, showing sausage, parchment paper, and container

Date____________________, 192__.

Name of carrier____

Shipper____

Point of shipment____

Consignee____

Destination____

I hereby certify that the following-described uninspected meat or meat food products are from animals slaughtered by a farmer on the farm and are offered for transportation in interstate or foreign commerce as exempted from inspection according to the act of Congress of June 30, 1906, and that at this date they are sound, healthful, wholesome, and fit for human food, and contain no preservative or coloring matter or other substance prohibited by the regulations of the Secretary of Agriculture governing meat inspection.

Kind of product	Amount and weight
----------------------------------	----------------------------------
----------------------------------	----------------------------------
----------------------------------	----------------------------------

-- (Signature of shipper)

-- (Address of shipper)

Any retail butcher or retail dealer who wishes to ship meat by parcel post, if it goes to or through any other State, must first have a certificate, to be obtained from the United States Department of Agriculture, exempting his business from inspection. For each shipment he must fill out and file with the postmaster two copies of the following form:

Date-------------------, 192--.

Name of carrier--
Shipper ---
Point of shipment--
Consignee ---
Destination--
Number of exemption certificate--

I hereby certify that I am a retail butcher or a retail dealer in meat or meat food products; that the following-described meat or meat food products are offered for shipment in interstate or foreign commerce under a certificate of exemption issued to me by the United States Department of Agriculture, and that at this date they are sound, healthful, wholesome, and fit for human food, and contain no preservative or coloring matter or other substance prohibited by the regulations of the Secretary of Agriculture governing meat inspection.

Kind of product	Amount and weight
----------------------------------	----------------------------------
----------------------------------	----------------------------------
----------------------------------	----------------------------------

-- (Signature of shipper)

-- (Address of shipper)

Each certificate of this kind shall show the exemption certificate number of the shipper.

Anyone who wishes to make interstate shipments of meats that have been Government inspected must file a copy of the following certificate, properly filled out, with the postmaster: *Provided* the meat bears the marks of Government inspection:

Date -------------------, 192--.

Name of carrier--
Shipper--
Point of shipment--
Consignee ---
Destination--

I hereby certify that the following-described meat or meat-food products, which are offered for shipment in interstate or foreign commerce, have been United States inspected and passed by the Department of Agriculture, are so marked, and at this date are sound, healthful, wholesome, and fit for human food.

Kind of product	Amount and weight
----------------------------------	----------------------------------
----------------------------------	----------------------------------
----------------------------------	----------------------------------

-- (Signature of shipper)

-- (Address of shipper)

The signature of the person making the shipment or the person who mails it must be written in full on the certificates filed with the postmaster.

These certificate requirements are issued by the Bureau of Animal Industry, United States Department of Agriculture, and that bureau permits certificates to be printed, typewritten, made with a rubber stamp, or in handwriting, but specifies that they should be on paper 5½ by 8 inches in size so as to be convenient to file.

The foregoing requirements in regard to certificates to be filled out and filed in connection with parcel-post shipments of meats apply also to shipments of meats made by any other means of public-carrier transportation.

MARKING AND MAILING PARCELS OF MEAT

Parcel-post shipments of meat should be marked "perishable," and the words "fresh meat" should be used. Fresh meats should be mailed as near time for dispatching mail as possible, preferably in the evening. If parcels are mailed on rural routes, the carrier should be asked to give them the best care possible until he delivers them at the post office. Exposure to the midday heat for several hours often causes trouble. Sometimes lack of care of perishable parcels mailed on rural routes before they reach the post office causes more damage than the entire further mail service through which they go. The post-office requirements for mailing fresh meat are the same as those for dressed poultry.

SHRINKAGE IN SHIPPING MEATS BY PARCEL POST

There is no appreciable shrinkage or loss in weight in shipping cured meats by parcel post, but fresh meats, if sent some distance, rarely weigh as much when received as when shipped. Although the loss in weight usually is small, it affects the price per pound. Every ounce of loss in weight increases the price per pound to the consumer and decreases the margin between country and city prices. A loss in weight of an ounce on a 3 or 4 pound shipment makes a very small difference in the price per pound, but a loss of an ounce on a pound would be noticeable both in weight and price.

The loss in weight of meat in parcel-post shipments varies greatly with the kind of meat, method of packing, length of time in transit, temperature, and other factors. In experimental shipments of fresh meat received by the Department of Agriculture the shrinkage varied from practically none to as high as an ounce per pound. This maximum shrinkage occurred in only one of the shipments. The average loss in weight was less than one-fourth ounce per pound, or approximately 1½ per cent.

Unless consumers know that loss in weight occurs in meat shipped by parcel post, dissatisfaction often results when they receive meat that weighs less than the weight stated by the producer. The shipper should try to avoid dissatisfaction by taking care to see that the meat, when chilled ready for shipment, weighs as much as the weight reported to the customer.

BUTTER

Butter is highly perishable unless it is handled under proper conditions; yet the fact that many consumers obtain their supplies direct from producers by parcel post, proved by the quantity passing through many post offices, indicates that parcel-post marketing of butter is feasible. It is usually an economical method, as the cost of market distribution through the regular wholesale and retail channels of trade is relatively high in comparison with the cost of shipments by parcel post from the first and second and sometimes more distant zones.

Well-made butter, thoroughly chilled before shipping, when packed in a suitable container, can be marketed satisfactorily by parcel post when extreme high temperatures are not encountered. Under ordinary conditions, where the butter does not melt and a firm or semi-firm condition is maintained, the shipping of butter by parcel post generally may be successful. Even though proper safeguards are taken, shipments made during extremely hot weather are likely to arrive in an oily and unsatisfactory condition.

QUALITY AND CONDITION OF BUTTER

Every possible precaution should be taken before shipment. Particularly is this true of farm-made butter, because conditions affecting its quality and condition usually can not be controlled as easily on farms as in creameries.

It is necessary to maintain proper conditions in the care of the milk and cream and the making of butter if a marketable product is to be produced. Too much importance can not be given to the maintaining of cleanly conditions in the stable and in other places where the milk, cream, or butter are produced or kept, for they absorb odors and spoil very quickly. It is important, too, that these products be kept in a cool place. High temperatures should always be avoided, as heated cream or butter produces a soft, oily, undesirable condition in the finished product. In manufacturing butter on the farm or in a factory the buttermilk must be removed and washed out and the proper amount of salt must be incorporated evenly.

PREPARATION OF BUTTER FOR PARCEL-POST SHIPPING

Frequently parcel-post shipments of farm butter are unsatisfactory to customers because proper methods were not used in making it, and the quality and condition of the butter were injured before it was shipped. For the satisfaction of customers it is important that a uniform quality of butter be produced. Some customers may prefer " sweet " butter, which is butter made without salt.

The methods used in preparing butter for parcel-post shipping depend largely upon the local conditions and the style of package used. To insure delivery in the best possible condition the butter after being packed or printed and placed in cartons should be chilled or hardened thoroughly before it is shipped.

One of the most satisfactory ways of preparing butter for shipment is to form regular 1-pound prints. The standard print measures 2½ by 2½ by 4⅝ inches. A hand butter printer or mold, such as can be purchased at almost any store that handles farmers' supplies, should be used in forming the prints.

Each pound print should be neatly wrapped in regular butter parchment or paper. A second thickness of such paper has been found to add materially to the carrying possibility of the butter. Waxed paper may be used for the second wrapping. As a further protection to the print, it should be placed in heavy manila paraffined cartons, which may be obtained from companies manufacturing folding paper boxes or from dairy-supply houses.

SHIPPING CONTAINERS FOR BUTTER

Corrugated fiber-board shipping containers of various sizes may be obtained for shipping 1-pound prints of butter. (See fig. 22.)

These containers partially insulate the butter and furnish much protection against heat. Further protection may be obtained by wrapping the container in stout wrapping paper and tying it securely. Metal containers are used for combination shipments of butter and eggs.

Butter shipped in an improvised container should be wrapped in parchment paper and several thicknesses of newspaper and then securely tied with string. The package should then be inclosed in the piece of corrugated paper board with the projections of the paper board so folded as to form a container. The container should then be tied, wrapped in heavy wrapping paper, and again tied securely.

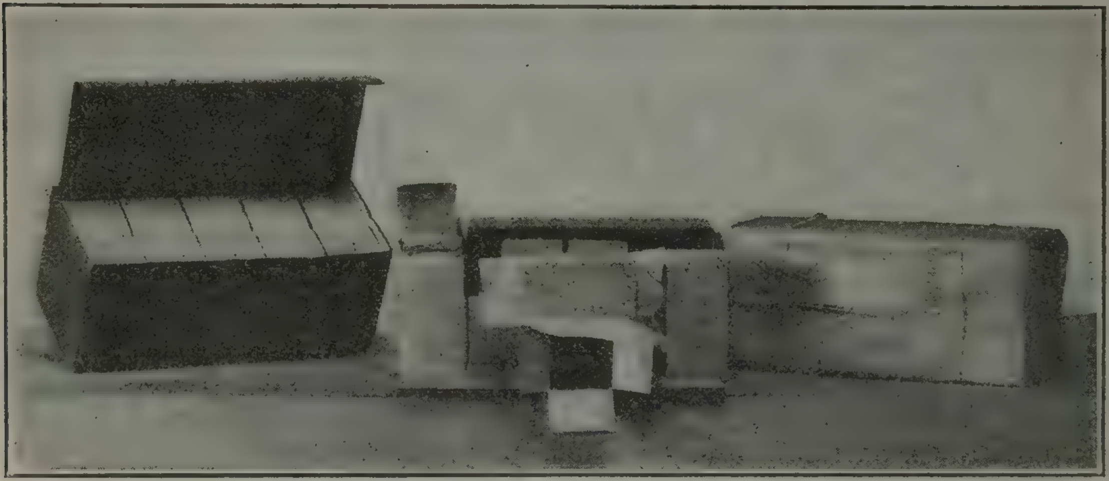

FIG. 22.—Three stages of a parcel-post package of butter: At right, wrapped; left, opened; center, showing print of butter

As butter is highly perishable, parcels containing butter should be marked "Butter—keep from heat," or with similar words.

For the improvised carton shown in Figure 23 the paper board was so cut that it was 7½ inches wide and 25 inches long, with projections in the middle of the length which were 4½ inches wide and extended 8½ inches on each side. This provided a carton 4½ by 6 by 7½ inches, when folded, as shown in the illustration.

If butter that is being prepared for shipment in this way is thoroughly chilled before being mailed, it should carry safely even in warm weather if it is in transit not over 24 to 36 hours.

CHEESE

Most varieties of cheese can be shipped any distance by parcel post without difficulty.

The two important varieties of cheese produced on farms are cottage cheese and American (full cream or whole milk) cheese. Cottage cheese is soft and perishable. When made rather dry and packed in moisture-proof packages, it may be shipped to points where delivery can be made within 24 to 36 hours. As the firmer varieties of cheese are ripened or cured and paraffined before they are marketed, they can be more successfully shipped by parcel post than can cottage cheese.

General care should be exercised in the packaging of cheese for shipment by parcel post. The surface of the cheese should be clean and, if necessary, paraffined. As a protection to the cheese, it should be wrapped in several layers of paper, preferably with a waxed paper next to the cheese. Corrugated or other fiber-board containers or wooden boxes may be used as shipping containers. Some cheese producers manufacture a small size, weighing from 2 to 5 pounds, suited for parcel-post shipment.

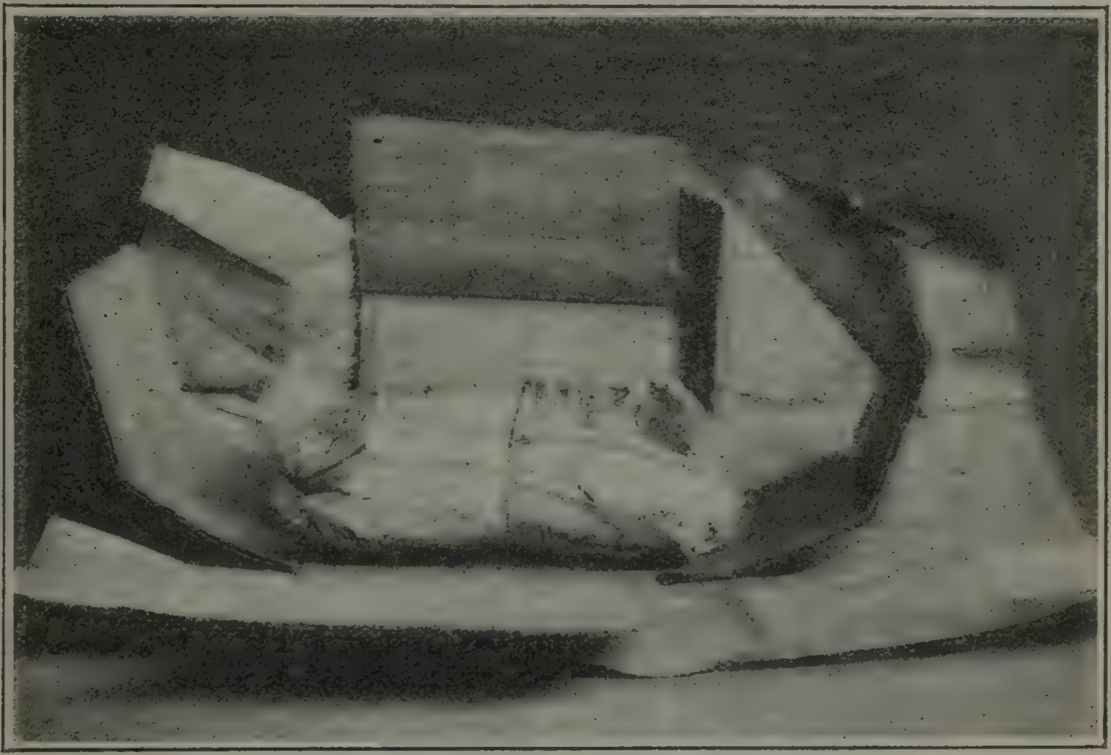

FIG. 23.—Actual parcel-post shipment of 3 pounds of butter wrapped in parchment paper, several thicknesses of newspaper, corrugated paper-board carton, and finally an outside wrapper of heavy wrapping paper

CREAM AND MILK

CREAM

At the request of the Post Office Department, the Bureau of Dairy Industry, United States Department of Agriculture, issued the following instructions to parcel-post cream shippers:

Unless cream is properly produced and handled it is apt to spoil en route. This is due to the action of yeasts and bacteria that have gotten into the cream. It may damage other mail and become a nuisance and be a loss to the shipper. This may be prevented if the producer will observe only a few simple precautions. Cream which will keep may be produced by following the suggestions given here:

Clean, healthy cows and milkers.

Brush visible dirt off flanks and udders before starting to milk.
Wipe udders and flanks with clean damp cloth.
Keep stables clean and see that cows have plenty of fresh air.
Wash hands before milking.
Milk with dry hands.

Use clean, sanitary, sterilized utensils.

Use only smooth tin utensils.
Wash utensils immediately after using.
Boil strainer cloth every time it is used.
After washing scald with boiling water or steam everything with which the milk or cream comes in contact.
Be sure the shipping can is washed clean and thoroughly sterilized with steam or boiling water.
Store the utensils in sunlight when possible, inverted and out of dust.

Use a centrifugal cream separator because—

Cream may be shipped fresher.
More butterfat is secured.
Richer cream is obtained; therefore, less weight to ship.
Richer cream will keep better.
Pan setting is undesirable, because it is favorable to bacterial growth.

Keep separator clean.

Take apart, wash, and scald every time it is used.

Take special care of cream.

Cool cream immediately after separation.
Never mix warm and cold cream.
Make shipments as frequently as possible.
Hold at low temperature. In cold weather protect from freezing.
Do not leave at roadside longer than necessary.
Provide protection from sun and dust while awaiting collection.

KEEP CREAM CLEAN, COVERED, COLD

The container used is the regulation or usual type of can for handling cream. The name and address of the owner of the can should be put on the can either with paint or with metal letters soldered on.

MILK

Should a producer be justified from the economic viewpoint in shipping milk by parcel post, the instructions given for the care of cream should be used in so far as applicable.

MUSHROOMS

As mushrooms are an article of comparative high value per pound, they can readily be shipped by parcel post. Any suitable container can be used, and they should be marked or labeled, as suggested for other commodities, to prevent crushing. The producer of mushrooms need not necessarily be near his market, as they will stand considerable transportation by parcel post.

NUTS AND NUT MEATS

The nuts most commonly grown in the United States under cultivation are English (Persian) walnuts, almonds, and pecans. The native nuts, like black walnuts, butternuts, or white walnuts, hickory nuts, and shellbarks, and the wild-growing pecans, may also be included in parcel-post shipments, as they are not perishable when sent through the mails. They can be shipped in any suitable container, like a bag of stout muslin or a corrugated paper board or other secure box. The nuts should be properly ripened and should be in good marketable condition. Those with worms or defects from other causes should be sorted out.

Nut meats are easily marketed by parcel post direct to the consumer, and especially for the holiday season may constitute a source of revenue to the farm boys and girls. The nuts should be gathered at the proper time and should be properly cured, so that the cracking out of the meats may be accomplished in time for the holiday trade. In cracking the nuts care should be taken to get out as many halves as possible. The small particles or crumbs should be kept for home use, although there may be housewives who would be willing to buy small pieces of nut meats at an appropriate price for use in cakes, taffy, candies, and salads. Care must be exercised to keep out the small pieces of nut shells. A good container of corrugated board or any suitable material can be used. Putting the nut meats into a bag of light material will prevent leaking in case the container should become damaged. They should be labeled on the outside of the parcel " Nut meats," with the words " Do not crush " added.

MAPLE SUGAR, SIRUPS, AND HONEY

Maple sugar can readily be marketed by parcel post, preferably in a box of proper size suitable for the purpose. It can be shipped any distance that the cost of postage justifies.

Maple sirup, cane sirup, sorgo sirup, etc., can be shipped by parcel post when put into a tin container with secure screw cap, as shown in Figure 24, and the tin container inclosed in a corrugated paper-board box. Friction-topped pails should not be used unless inclosed in a wooden crate or box; if inclosed in a corrugated paper-board box, there is danger that the top of the pail may be accidentally sprung enough to cause leakage.

Extracted honey can be shipped in the same way as sirups. Comb honey should be placed in a friction-top pail and then securely crated.

PLANTS AND CUT FLOWERS

Practically all kinds of vegetable and flowering plants and cut flowers can be shipped by parcel post if proper care is given in preparing them for shipment by supplying appropriate ventilation and moisture. Sphagnum moss or some similar packing material which retains moisture may be used in packing plants for shipment. It should be made thoroughly damp but not wet enough to cause leakage or dripping of water. The wrapping next to the plants and damp packing material should be of parchment, butcher's paper, or other paper relatively impervious to water. A producer who wishes to ship flowers by parcel post should make a special study of how florists pack flowers for shipment, as improper packing will destroy the value of the cut flowers. Most cut-flower boxes are provided with lids which allow practically no ventilation. The individual grower and shipper of flowers will need to work out his packing problems as his market may require.

OTHER ITEMS

There are many other items which, if given special attention, could doubtless be marketed direct. Seasoning herbs like sage, dill, and sweet marjoram, wild or natural "teas" like peppermint, pennyroyal, wood's dittany, and bergamot, and such greens as cress and mustard lend themselves readily to parcel-post marketing. The person who has the knack for such marketing will think of other commodities for which a market is not readily available. In this way the time spent in the actual work of marketing may be largely at the farmer's convenience, and it may afford employment for spare time, especially in the winter or at other occasional slack seasons.

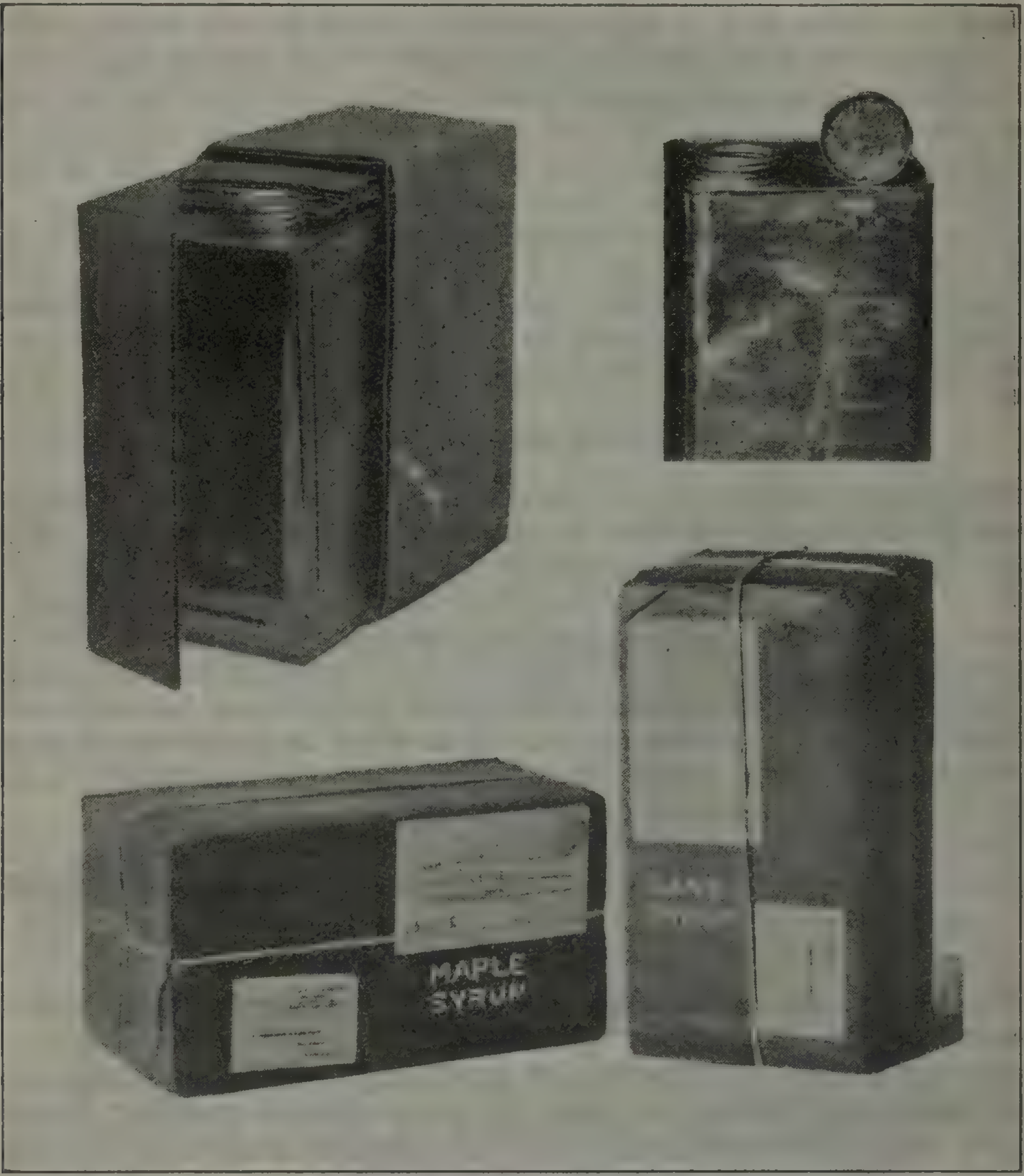

Fig. 24.—Tin containers and corrugated paper-board jackets or outer containers for sending liquid sweets through the mails. Such containers have proved satisfactory

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1552

FUR LAWS

FOR THE SEASON

1927-28

1862 1889

TO ENCOURAGE effective action on the part of those concerned in maintaining the supply of fur animals, including trappers, fur tradesmen, administrative officials, legislative committees, and conservation societies, the information in this bulletin, the thirteenth annual summary of the fur laws, is published. The primary responsibility for making and enforcing laws to protect fur animals rests with the individual States. The policy of the department regarding fur conservation is intended to be cooperative, advancing the common interests of the public. The more the spirit of cooperation prevails on the part of all concerned, the brighter will be the prospects for the perpetuation of fur animals as a commercial resource and as an interesting part of our native wild life.

Washington, D. C. October, 1927

FUR LAWS FOR THE SEASON 1927-28

By FRANK G. ASHBROOK, *in Charge, Division of Fur Resources,* FRANK L. EARNSHAW, *Assistant Interstate Commerce in Game,* and FRANK G. GRIMES, *Junior Administrative Assistant, Division of Migratory-Bird Treaty and Lacey Acts Enforcement, Bureau of Biological Survey*

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FUR RESOURCES STEADILY DIMINISHING

OF VITAL INTEREST to persons who make their living from furs is the maintenance of a continued source of supply, and all concerned in any branch of the fur trade are jointly responsible for the permanence of the fur resources of the country. Trappers would fare better if they would limit trapping to periods when the fur is prime and if they would exercise care in removing pelts and curing them properly before shipment. Receiving houses are partly responsible for waste of fur through their practice of sending out early price lists containing quotations on prime furs, which are not then obtainable—virtually an invitation to trappers to begin operations too soon. By such action not only do receiving houses accept unprime pelts and thus encourage overtrapping, but the trapper's return is smaller than it would be from prime fur.

Other factors contributing to the steady dimunition of fur stocks include a general tendency in many sections to class fur bearers as vermin to be killed on sight; a great reduction of fur-producing areas; unwise drainage of swamps and marshes; and needless destruction of forests and cover. The raw-fur catch during 1925-26 was approximately 20 per cent lower than in the previous year, and the decrease for 1926-27 was even greater. The problem of conserving the remnant of the fur supply and of supplementing it from other sources must be faced by all who are interested in the future of one of the oldest industries of the country.

The responsibility of the individual States in the protection of fur animals and in fur-law administration is becoming more fully recognized. The States are more and more appreciating the fact that they must make and enforce appropriate fur-conservation laws and that if they do not, the public and private benefits from the fur resources will diminish to the vanishing point in the not distant future.

There are persons who consider fur animals primarily as economic assets to be used for commercial purposes; others look upon them only as enemies of game and poultry to be destroyed as vermin; still others maintain strictly esthetic views. The Biological Survey recognizes the merits of all these viewpoints, but that no one of them can be emphasized to the exclusion of the others if the permanent economic use and esthetic enjoyment of our fur resources is to be assured.

INTERSTATE SHIPMENTS OF PELTS

The United States Department of Agriculture, through the Bureau of Biological Survey, is in position to aid State authorities in the prosecution of many violators of State conservation laws through the provisions of the Federal Lacey Act, which governs interstate shipments of wild animals. This legislation, enacted on May 25, 1900, and amended and incorporated in the Criminal Code of the United States on March 4, 1909, prohibits the delivery of the dead bodies or parts thereof of wild animals to any common carrier for transportation from one State to another when such animals have been killed or shipped in violation of the laws of the State in which killed or from which shipped. It stands continually on guard as a supplement to State legislation for the protection of wild animals, and deserves careful study by all concerned in revising and framing State laws relating to fur animals, if the States are fully to avail themselves of its provisions. Although this law carries no police power, and although the Federal wardens employed in its enforcement are not empowered to seize illegal shipments of furs or game animals, the department and the Federal wardens under its jurisdiction maintain close cooperation with the various States. Many violators are apprehended through the activities of Federal agencies operating under this law, and as a result thousands of dollars in penalties annually accrue to the States.

A violation of the Lacey Act is predicated upon a violation of the State law, but owing to the present status of State laws it is seldom possible to institute Federal prosecutions for illegal shipments of furs. The actual evidence of the illegal killing of fur animals is most difficult for the department to obtain as compared with the documentary evidence of shipments. For instance, frequently a State will protect beavers for an indefinite term or for a period of years, but will fail to make provision concerning the possession, sale, and shipment from the State of skins of such animals during the continuance of the close season.

In enforcing the provisions of the Lacey Act it has been found that most reputable raw-fur houses are eager to cooperate to the fullest extent in the suppression of traffic in unprime and contraband skins. The outstanding need in connection with traffic in beaver skins is for a system of branding, perforating, or permanently marking those legally taken so that they may be satisfactorily identified and traced to the point of origin. With some such fairly uniform system in vogue in the beaver-producing States, reputable raw-fur dealers would be in position to refuse to handle contraband skins.

The system of tags, affidavits, and shipping permits in connection with the payment of royalties on furs in most of the Provinces of Canada appears to work to advantage in the suppression of illegal traffic in skins of fur-bearing animals. Upon the payment of the royalty a tag is provided, half of which is surrendered for an export permit, while the stub remains attached to the skin as evidence that the royalty has been paid.

The system has been further developed in British Columbia, where royalties are required to be paid on all furs intended for export and for shipment within the Province for tanning and dressing. Bales of furs for shipment are required to be inspected. Shipments must then have lead seals attached and be accompanied to destination by export permits, duplicates of which are forwarded to the game department of the Province or State to which the fur is being shipped. Other State and provincial game departments will quickly recognize the value of opportunities to check shipments of furs received from beyond their borders and the possibilities in cooperation of preventing illegal interstate traffic in furs.

REVIEW OF LEGISLATION OF 1927

TENDENCIES

The legislatures of all the States except Kentucky, Louisiana, and Mississippi were in session since the last bulletin on the fur laws was issued (Farmers' Bulletin 1515, Fur Laws for the Season 1926–27). The changes in most of the States in laws relating to fur animals were of minor importance, but in a few extensive revisions were made.

The general tendency of the year's legislation was to increase protection on fur-bearing animals, particularly on beavers. Statewide fur seasons were prescribed in North Carolina, and general revisions were enacted in Arkansas, Florida, Maryland, and Oklahoma. The trapping seasons on certain species were shortened in California, Kansas, Maine, Pennsylvania, Alberta, Nova Scotia, and Ontario, while some seasons were lengthened in South Dakota, Utah, and Wyoming.

LICENSE LEGISLATION

The fees for licenses to take fur animals were increased in Pennsylvania, Rhode Island, Alberta, and Mexico. Licenses to deal in furs were prescribed in Florida, Kansas, New Hampshire, North Carolina, North Dakota, and Washington, and in most of these States dealers are now required to render monthly, quarterly, or annual reports of their operations.

LEGISLATION REGARDING BEAVERS

One of the most noteworthy revisions effected in any State concerned the traffic in beaver skins in Montana. As heretofore beavers may be taken under permit of the State fish and game warden when the animals are actually doing damage, and the skins after being duly tagged may be disposed of under permit of the warden. In order to safeguard the beavers of the State, skins of animals imported into Montana must be forwarded to the State game warden for tagging within three days after arrival, together with evidence showing the legal taking and removal from the State in which captured or from which exported. After being tagged by the State warden, such skins may be possessed and sold in the State, and their export is provided for under proper shipping permit of the warden. The State law was formerly held not to apply to imported beavers, and in order successfully to prosecute violators it was necessary to prove that the animals from which skins were taken were killed in Montana. This new legislation should render the State law much more effective.

Close seasons on beavers were extended for a period of years in Arizona and Alberta, and the trapping of these animals was prohibited in Florida, North Carolina, Manitoba, and Saskatchewan.

In Alaska an additional area in the central portion of the Territory was opened to beaver trapping during the month of April, and a limit of 10 a season set for each trapper. California made a statewide season for beaver trapping, thus changing the provisions of last year, under which beavers could be taken in districts 1, 2, and 3 at any time.

The beaver-trapping law was strengthened in New Mexico by requiring skins taken under permit to be disposed of by the State game warden, half the proceeds realized from sales to be turned over to permittees. North Dakota provided for the protection of property against damage by beavers by allowing them to be taken by bonded deputies or agents of the commission. Live animals or the skins of animals so taken are declared the property of the commission. In Washington, the State supervisor of game and game fish was authorized to issue permits to take beavers doing damage to property in the State.

OTHER FUR LEGISLATION

Additional protection was afforded muskrats in Maine, where the season was shortened two weeks in the northern part of the State. In Michigan the trapping of muskrats was prohibited for two years, and in South Dakota the close season on muskrats east of the Missouri River was extended to December 1, 1929. Iowa opened the State to muskrat trapping from November 15 to March 15 but prohibited the taking of the animals on meandered lakes and streams or within half a mile of their borders.

In Maryland a State season on raccoons and opossums from November 1 to February 1 replaces the local laws that formerly prevailed in several counties. In Pennsylvania the season on raccoons was shortened one month, and in Ontario three months.

Oklahoma prohibited the trapping of minks and martens, or sables, by closing the season for a term of years.

South Carolina made it unlawful for any person, firm, or corporation to set, sell, make, or use a steel trap or any like device in the State, but allows the setting of such traps for the protection of property within 25 yards of poultry houses or within 200 yards of residences.

The Department of the Interior promulgated regulations under the act of July 3, 1926, governing the leasing of public lands in Alaska for fur-farming purposes.

SUMMARY OF LAWS

Legislation for the protection of fur animals has not progressed in some States to the stage of stringent regulation, and this condition, together with the fact that such legislation is in the formative period, makes it often exceedingly difficult to determine what restrictions apply to transporting and marketing furs.

In stating the open season the plan has been followed, as in the bulletin on the game laws,[1] to include *the first and last days thereof.* Statements regarding trapping on lands of another do not take into consideration the general trespass laws of the State. The bounty laws included relate for convenience to all animals and birds on which bounty is paid.

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[1] Laws relating to game animals, including deer and other big game, rabbits, and squirrels, will be found in Farmers' Bulletin No. 1550, Game Laws for the Season 1927–28.

FEDERAL LAWS

Two Federal laws have a bearing on the fur industry of the United States—the Lacey Act, governing interstate commerce in wild animals, and the tariff act of September 21, 1922.

That part of the Lacey Act codified as section 242 of the Criminal Code (35 Stat. 1137) makes it unlawful to deliver to a common carrier for transportation "from any State, Territory, or District of the United States to any other State, Territory or District thereof" the bodies or parts of bodies of any wild animals killed or shipped in violation of the law of the State, Territory, or District in which killed or from which shipped.

The tariff act of September 21, 1922, places a duty of 15 per cent ad valorem on all live wild animals shipped into the United States. This includes silver and black foxes, the skins of which, dressed or undressed, and manufactures thereof, are dutiable at 50 per cent ad valorem. Other furs dressed on the skin, not advanced further than dyeing, are dutiable at 25 per cent ad valorem. Raw furs and skins (except silver and black fox skins) are admitted free.

The regulations of the Department of Agriculture for the inspection, quarantine, and entry of foxes have been rescinded. Foxes may now be brought in at any port on presentation of the regular importation permits and payment of the duty imposed by the tariff act.

LAWS OF STATES

ALABAMA

Open seasons: [2]	*Dates inclusive*
Beaver, otter, bear, raccoon, fox, opossum, mink, muskrat (trapping)	Nov. 1–Feb. 29.[3]

Prohibited methods: Unlawful to set traps in such manner as to endanger domestic stock.

Licenses: Fee, $15 for first trap and $2.50 for each additional trap; issued by probate judges. Landowners or landlords, and members of families may trap on own land during open season without license. Written permission required to trap on land of another.

Possession and sale: Possession of the young of protected fur animals prohibited during close season. No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: Under special permit from commissioner of game and fisheries fur animals may be captured or possessed for propagation.

Bounties: None paid.

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[2] *Alabama:* Owner may protect premises in any manner at any time from depredations of fur animals.

[3] Fur animals may be hunted with dog or gun: Sept. 1–Feb. 29.

ALASKA [4]

Open seasons: [5]	*Dates inclusive*
District 1: [6] [7]	
Beaver (Alaska Peninsula only)	May 1–May 31.
Rest of district	No open season.
Muskrat	Dec. 16–Apr. 30.
Land otter, mink, weasel (ermine), east of longitude 138°	Jan. 1–Mar. 1.
West of longitude 138° (see exception)	Dec. 16–Mar. 31.
Exception: Land otter, weasel (ermine) in Kodiak-Afognak Islands group	Dec. 1–Feb. 15.[7]
Red, cross, and silver foxes, lynx	Nov. 16–Jan. 31.
Blue fox (on Aleutian Islands Reservation only)	Nov. 16–Jan. 31.
Black bear (including its brown and blue, or glacier bear, color variations)	Oct. 1–May 31.
Wolf, coyote, wolverene, marmot, ground squirrel	No close season.
District 2: [8]	
Beaver, in western portion of district	May 1–May 31.[9]
South summit of Alaska Range and east summit of Mount Spur and Chigmit Mountains	Apr. 1–Apr. 30.[9]
Rest of district	No open season.
Muskrat, south summit of Alaska Range and Ahklun Mountains	Dec. 16–Apr. 30.
North summit of Alaska Range and Ahklun Mountains (see exceptions)	Mar. 15–May 31.
Exceptions: In Lower Kuskokwim and Yukon drainages	May 1–June 10.
In Tanana drainage	Mar. 15–May 15.
Land otter, mink, weasel (ermine), south summit Alaska Range and Ahklun Mountains	Dec. 1–Mar. 1.
North summit of Alaska Range and Ahklun Mountains	Nov. 16–Mar. 1.
Fox, lynx, south summit of Alaska Range and Ahklun Mountains	Nov. 16–Jan. 31.
North summit of Alaska Range and Ahklun Mountains (see exception)	Nov. 16–Mar. 1.
Exception: On Seward Peninsula, including drainage of Kiwalik and Koyuk Rivers	Dec. 1–Mar. 15.
Black bear (including its brown and blue, or glacier bear, color variations) (see "Bag limits")	Sept. 1–June 20.
Polar bear, wolf, coyote, wolverene, marmot, ground squirrel	No close season
District 3: [10]	
Beaver (see footnote 9)	May 1–May 31.
Muskrat	Apr. 1–May 31.
Mink, land otter, weasel (ermine), fox, lynx	Nov. 16–Mar. 15.
Black bear (including its brown and blue, or glacier bear, color variations), polar bear, wolf, coyote, wolverene, marmot, ground squirrel	No close season.
Throughout Territory:	
Beaver (except as above), marten, sea otter	No open season.
Bear (large brown or grizzly)	Sept. 1–June 20.[11]

Prohibited methods: Unlawful to take or kill land fur animals with poison, by use of trap or device known as the "klips," steel bear trap, or any other trap with jaws having a spread exceeding 9 inches, by aid or use of a shotgun, fire, jacklight, pit lamp, searchlight, or other artificial light, or (except polar bear) by aid of a dog. No fur animal may be taken from its home

ALASKA—Continued

Prohibited methods—Continued.
or den by digging, smoking, or the use of chemicals, and no home, house, den, or runway of a beaver or muskrat may be injured or destroyed.

Bag limits: Three large brown or grizzly bears a season; 20 beavers a season, except in fur district 2, south of Alaska Range and Ahklun Mountains only 10 beavers may be taken in a season. In fur district 2, south Alaska Range and Ahklun Mountains, not more than 2 black bears may be taken in September.

Licenses: *Trapping:* Nonresident, $50 (nonresident, hunting large brown or grizzly bears, must have registered guide); resident[11] $2 (not required of residents under 16 years of age, nor of native-born Indians, Eskimos, or half-breeds who have not exercised the right of franchise or severed their tribal relations). Alien, $100 (special license, issued by members of commission). Fur farm, $2. *Fur dealer:* Resident, $10. Nonresident citizen, or corporation, association, or copartnership organized under laws of Territory, or a State of the United States, $250. Alien, or a corporation, association, or copartnership not organized under the laws of Territory, or a State of the United States, $500 (agents, nonresident citizen, $250; resident, $10). Licenses issued by members of commission, game wardens, and authorized agents. Licensed fur dealers must keep complete records of all fur transactions. Dealer's license not required of native-born resident Indian, Eskimo, or half-breed who has not exercised right of franchise or severed his tribal relations, or of a hunter or trapper to sell skins of fur animals he has lawfully taken, or of fur farmer to sell skins of animals raised by him and a person not engaged or employed in the fur trade may buy furs for his own use, but not for sale.

Licensees, within 30 days after expiration of license, must report to game commission, Juneau, number and kind of fur animals taken, purchased, or otherwise procured under license. Fur dealer and fur farmer must also comply with Territorial laws and keep records.

Possession and sale: No restrictions on prime skins legally taken or on beaver skins duly sealed. Beaver skins legally taken must be sealed within 90 days after close of season. Fur dealers required to be licensed (see "Licenses"). Blue-fox skins must be tagged or branded before being sold.

Shipment and export: No restrictions on prime skins legally taken, but no person who is engaged in fur farming or the fur trade as a dealer or agent shall possess or transport such furs without a license. Skins of beaver properly sealed may be possessed and transported at any time. Blue-fox skins (other than those raised on farms having a registered brand and branded with such brand) whether acquired in Territory or imported, must be tagged (fee, $1.50) by United States commissioner.

Shipment must be accompanied by statement showing number and kind of skins therein and that no unprime skin is included, such statements to be taken up and mailed to Alaska Game Commission, Juneau, by collectors of customs when by freight or express, by postmasters, when by parcel post, or direct to commission by shipper when by other means.

Nonresident citizen or alien may export three large brown or grizzly bears under hunting license coupons and affidavit of lawful killing.

Resident may export for mounting and return within one year, two heads or trophies of large brown or grizzly bears legally killed, under permit, fee $1 for each trophy. Resident citizen removing from Territory may export large brown or grizzly bears legally acquired, under permit, fee $5, for each specimen. (See "Licenses.")

Propagation:[12] License, fee $2, must be obtained from Alaska Game Commission, to conduct a fur farm or to possess fur animals for propagation. Fur animals may be taken for propagation under permit from Secretary of Agriculture and countersigned by executive officer of the commission. Blue-fox farmer must register brand, fee $10.

ALASKA—Continued

Propagation—Continued.
On Aleutian Islands Reservation and certain other islands, permits to use the islands for fur farming and to trap animals for breeding purposes must be obtained from Department of Agriculture.

Public lands in Alaska for fur-farming purposes may be leased from the Department of the Interior under the act of July 3, 1926, and regulations thereunder.

Bounties: Wolf, $15; eagle, $1; hair seal (southeastern Alaska, east 152d meridian) $2 (paid by Territory).

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[4] *Alaska:* Regulations under Alaska game law of Jan. 13, 1925, relating to land fur animals may be obtained upon application to Secretary of Agriculture, Washington, D. C., or to Alaska Game Commission, Juneau, Alaska. For special information regarding sea otters and fur-seal fisheries and Afognak Reservation, which are subject to special legislative and administrative control, application should be made to Commissioner of Fisheries, Washington, D. C. For law and regulations governing leasing of public lands in Alaska for fur-farming purposes, application should be made to the Commissioner, General Land Office, Washington, D. C.

[5] Unlawful to kill land fur animals when the fur is unprime; the killing of all land fur animals on national bird and game refuges, Mount McKinley National Park, Katmai and Glacier Bay National Monuments, on Kruzof and Partofshikof Islands, or, except by occupant, on any island under lease or permit for fur-farming purposes, is prohibited.

[6] District 1 includes the Aleutian Islands, Alaska Peninsula, and neighboring islands, and southeastern Alaska, mainland and islands, from Cape Fairweather to Dixon Entrance.

[7] Land otter, weasel (ermine), on Kodiak-Afognak Islands Group—Dark Island on the north, Marmot Island on the east, and Tugidak and Trinity Islands on the west and south—Dec. 1–Feb. 15.

[8] District 2 includes the mainland and islands from Cape Fairweather, Gulf of Alaska, Iliamna Lake, and Bristol Bay, northward to the headwaters of the streams flowing into the Arctic Ocean north of the sixty-eighth parallel of north latitude.

[9] In fur district 2 the western portion includes all of district west of a line beginning at Kamishak Bay–Kahonak Bay portage at head of Alaska Peninsula, following summit of Chigmit Mountains, Mount Spur, Alaska Range, Alaska Railroad from Broad Pass to Nenana, Tanana River to Fort Gibbons, and the divide between streams entering the Yukon above and below Fort Gibbons, to summit of Endicott Mountains. In district 3, open only in drainage of the Noatak, Kobuk, Selawik, and Buckland Rivers. Limit, 20 beavers a season, except in district 2, south of Alaska Range and east of Chigmit Mountains, 10 a season. Skins must be sealed by commissioner, game warden, or other authorized person within 90 days after close of season.

[10] District 3 includes the region drained by the streams entering the Arctic Ocean north of the sixty-eighth parallel of north latitude and the drainage of the Noatak, Kobuk, Selawik, and Buckland Rivers.

[11] Large brown and grizzly bears are game animals and may be killed at any time to prevent damage to person or property. Resident license not required to take game animals.

[12] Unlawful to feed to a fox or other fur animal held in captivity, any part of a game animal or bird other than an eagle, a raven, crow, hawk, owl, or cormorant, except waste parts such as hides, viscera, and bones

ARIZONA

Open seasons:

Beaver	No open season.
Other fur and predatory animals	No close season.[13]

Prohibited methods: No restrictions.

ARIZONA—Continued

Licenses: Fee, $2.50; issued by warden, designated deputies, and clerks of boards of supervisors. License not required for trapping on own land, nor by persons under 18 years of age. Unlawful to disturb or remove traps of licensed trappers on public domain or on lands where they have permission to trap.

Possession and sale: No restrictions.

Shipment and export: No restrictions.

Miscellaneous: Unlawful to use fish or the flesh of any game bird or animal for trap bait.

Propagation: Under permit from State game warden, fur-bearing and predatory animals may be kept for propagation, exhibition, or sale.

Bounties: Payment of bounties is optional with county boards of supervisors.

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[13] *Arizona:* Mountain lion, wolf, fox, coyote, lynx, wildcat, skunk, or other obnoxious animals may be taken on State game preserves only under regulations of State game warden. Owner may protect his premises from depredations of predatory and fur animals at any time.

ARKANSAS

Open seasons:	*Dates inclusive*
Bear, beaver	No open season.
Fox in Ashley, Benton, Bradley, Clark, Clay, Cleburne, Columbia, Conway, Craighead, Crawford, Crittenden, Cross, Dallas, Desha, Drew, Faulkner, Garland, Grant, Green, Hempstead, Hot Springs, Jefferson, Johnson, LaFayette, Logan, Lonoke, Miller, Mississippi, Monroe, Montgomery, Nevada, Ouachita, Phillips, Pike, Pope, Pulaski, Randolph, Saline, Searcy, Sebastian, Sevier, Union, Washington, White, Woodruff, and Yell Counties	No open season.[14] [15]
In rest of State	No close season.
Wolf, bobcat, coyote	No close season.
Other fur animals	Nov. 15–Jan. 31.[15]

Prohibited methods: No restrictions.

Licenses: Trapping license, $20 (only required for use of more than 12 traps). Issued by State game and fish commission and circuit clerks.

Possession and sale: Sale or possession of pelt taken in State prohibited, except between November 15 and February 10. Fur dealer required to file report of pelts on hand February 10 and obtain permit to possess or sell pelts during close season.

Shipment and export: No restrictions, except fur dealers must report shipments within or without State.

Propagation: The State game and fish commission may issue permits to breeders of game and fur animals under such regulations as it may prescribe.

Bounties: County courts may fix the amount and offer bounties on wolves, wildcats, or panthers.

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[14] *Arkansas:* Chasing foxes by dogs permitted. Foxes so caught may be killed and pelts sold by sheriff of county for benefit of school fund of district in which taken.

[15] Fur animals found destroying crops or poultry may be killed at any time.

CALIFORNIA

Open seasons: [16] [17]	*Dates inclusive*
Black or brown bear (see exception), beaver,[18] muskrat, river otter, fisher, pine marten, skunk, fox, kit fox, ring-tailed cat, raccoon, wolverene	Nov. 15–Feb. 29.
Exception: Black or brown bear in districts 1, 1½, 2, 2½	No close season.
Seal and sea lion (see exception)	Unprotected.
Exception: Sea lion in game district 19	No open season.
Sea otter	No open season.

CALIFORNIA—Continued

Prohibited methods: Unlawful to use poisons or gun larger than No. 10 gauge in taking fur animals, or to dig or smoke out skunks from dens.

Licenses:[16] Citizen, $1; alien, $2; issued by fish and game commission. License issued free to veterans of Civil War. Duplicate license issued only on affidavit of applicant that original has been lost or destroyed. License not required of persons under 18 years of age. Licensed trappers required to report catch before July 1. Licensee must exhibit license and furs to wardens or peace officers upon demand. Unlawful to disturb or remove traps of licensed trapper who is trapping on the public domain or on lands where he has permission to trap.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions.

Propagation: Fur animals may be raised in captivity under regulations of the commission.

Bounties: Mountain lion, female, $30; male, $20; paid by fish and game commission. Boards of supervisors of counties may fix the rate and pay bounty on coyote, wildcat, fox, lynx, bear, or mountain lion. Many counties now pay a bounty on some of these animals, especially on coyotes.[19]

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[16] *California:* Written permission from board of fish and game commissioners required to trap or hunt predatory animals on State game refuges.

[17] Of the 72 fish and game districts created under the act of 1917, as amended in 1919, 1921, 1925, and 1927, 9 (1, 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾) are properly hunting districts; 23, 24, 25, and 26 are fishing districts but are open to hunting; of the other 59 districts, 32 are game refuges and 27 are fishing districts.

District 1 comprises the eastern half of the Sacramento and San Joaquin Valleys, including all counties not included in districts 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾.

District 1½ comprises the counties of Del Norte, Siskiyou, and Humboldt.

District 1¾ comprises Modoc and Lassen Counties.

District 2 comprises that part of the State south of Humboldt and Tehama Counties, west of the Sacramento River and north of San Francisco Bay, including the counties of Glenn, Colusa, Yolo, Solano, Napa, Lake, Sonoma, and Marin, and that portion of Mendocino County not included in district 2½.

District 2½ comprises townships in Mendocino County bordering on the Pacific Ocean, except townships 11 north, range 15, and 16 west, and townships 13, 14, 15, 16, 17, and 18 north, range 16 west.

District 3 comprises the region around the southern portion of San Francisco Bay and the coast counties south of the Golden Gate as far as Ventura, including the counties of Contra Costa, Alameda, Santa Clara, San Francisco, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, and Ventura; also San Benito and the western half of San Joaquin, Stanislaus, Merced, Fresno, and Kern Counties.

District 4 comprises counties in southern California, namely, Los Angeles, Orange, Riverside, and San Bernardino.

District 4½ comprises counties of Mono and Inyo.

District 4¾ comprises San Diego and Imperial Counties.

Districts 23, 24, 25, and 26, all located in district No. 1, are as follows:

District 23 comprises the drainage area of Lake Tahoe and the Truckee River in the counties of Placer and Eldorado.

District 24 comprises the drainage area of Silver, Twin, Blue, Meadow, and Wood Lakes in the counties of Alpine and Amador.

District 25 comprises the drainage area of Lake Almanor in the counties of Plumas and Lassen.

District 26 comprises Sixty Lake Basin, part of Rae Lake, and to the south fork of Woods Creek in Fresno County.

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[18], [19] For footnotes 18 and 19, see top of p. 8.

[18] Beaver doing damage to levees or other protective works in reclamation, levee, or swampland districts may be taken under permit from commission, such taking to be reported within 10 days, when commission issues permit for disposition of skins.

[19] For information in regard to bounties in any county, application should be made to the county clerk.

COLORADO

Open seasons:

Beaver	No open season.[20]
All other fur animals	No close season.[21]

Prohibited methods: No restrictions.

Licenses: Hunting license required to trap: Resident: General, $5; limited $2 (for coyote, mountain lion, wolf, bobcat, lynx); nonresident, $25; issued by commissioner, county clerks, and other agents. Unnaturalized resident not permitted to hunt, capture, or kill any wild bird or animal.

Possession and sale: No restrictions.

Shipment and export: No restrictions.

Miscellaneous: Use of game or fish for trap bait prohibited.

Propagation: No restrictions, except as to beaver and game animals.

Bounties: None paid by State since 1895. On petition of 50 freeholders, county commissioners may levy a tax to pay bounties on coyote, wolf, and mountain lion.

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[20] *Colorado:* The owner of property being damaged by beavers may be permitted to kill them under such regulations as may be provided concerning disposition of the skins by the State game and fish commissioner.

[21] A permit from the State game and fish commissioner is necessary to take mountain lion, wolf, coyote, fox, lynx, wildcat, mink, marten, or wolverene on State game refuges.

CONNECTICUT

Open seasons:[22]

	Dates inclusive
Muskrat	Nov. 1–Mar. 31.
Raccoon	Oct. 21–Dec. 31.
Fox, weasel	No close season.
Skunk, otter, mink, and other fur animals	Nov. 1–Mar. 15.

Prohibited methods: Unlawful to trap with scented baits or to take animals with a snare or similar device, to use steel traps having more than a 6-inch spread of jaws, or any steel trap having teeth except for otter. Poisoning fur animals prohibited. Unlawful to disturb muskrat house or den or to hunt muskrats from sunset to sunrise. Unlawful to take fur animals by use of dynamite or other explosive, gas, smoke, or chemical, or by digging from burrow or den. Traps must be visited at least once in 24 hours, and, on lands of another, must not be set in path, wood road, or specially prepared furrow. Owner or person using traps must have his name legibly stamped thereon.

Licenses: Hunting license required to trap: Resident, $2.25; nonresident, $10.25 (nonresident or alien owning real estate in State assessed at $500 or more, or his lineal descendant, may obtain license for same fee as resident); issued by city, town, or borough clerk. Persons under 16 years of age are denied a hunting license, but may obtain one for taking fur animals only. Licensee must wear button. License not required of residents hunting or trapping on own land during open season. Permission of owner required to trap on lands of another. Licensee required to report number of animals trapped each season. Taxidermist, $5; issued by board of fisheries and game.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: No restrictions on possession or sale of fur animals kept in captivity under license (fee, $2).

CONNECTICUT—Continued

Bounties: Any town may pay bounty of $5 for wildcat, fox, rattlesnake, copperhead snake, and $1 for weasel, woodchuck, and wild Belgian or German hare killed within its limits.

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[22] *Connecticut:* Fox, skunk, raccoon, wildcat, mink, or weasel may be hunted or trapped on State game preserves only by superintendent of fisheries and game or persons designated by him. Fur animals may be killed at any time for protection of property.

DELAWARE

Open seasons:[23]

	Dates inclusive
Skunk, mink, otter, muskrat	Dec. 1–Mar. 10.[24]
Fox	Oct. 1–Apr. 30.
Raccoon, opossum	Oct. 15–Jan. 15.

Prohibited methods: Unlawful to use pitfall, deadfall, scaffold, cage, snare, trap, net, pen, baited hook, or baited field, or any other similar device, or any drug, poison, chemical, or explosive for taking animals protected by State laws, except muskrat, skunk, mink, and otter. Traps or other devices unlawfully set are subject to confiscation. Unlawful to destroy the nest, den, or lair of any animal protected by law. Unlawful to hunt, kill, take, or destroy any protected animal, except muskrat, skunk, mink, and otter, while the ground is covered with snow. Unlawful to shoot at or destroy any fox while it is being chased by a dog. Muskrats may not be taken during the time any flood or freshet may cause them to leave their usual places of shelter and protection, nor may they be shot at night, hunted with a dog, or taken by the method commonly known as "nailing."

Licenses: Hunting license required: Nonresident, $10.50; resident, $1.10 (not required in county of residence nor on own land); issued by commission. Permission of owner required to take or kill muskrats on land or marsh of another.

Possession and sale: Unlawful to sell fox or fox hide. No other restrictions.

Shipment and export: Unlawful to export fox or fox hide. No other restrictions.

Propagation: No restrictions, provided a permit is obtained from the chief game warden (fee, $1). A limited number of wild fur or game animals for propagating purposes may be taken under permit.

Bounties: None paid.

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[23] *Delaware:* Owners may kill foxes at any time when destroying their poultry, and other fur animals may be killed at any time when destroying property.

[24] In New Castle County, on embanked meadows muskrats may be taken from Dec. 1 to Mar. 20.

FLORIDA

Open seasons:[25]

	Dates inclusive
Beaver, otter	No open season.
Skunk	No close season.
Fox, red or gray	Sept. 1–Jan. 31.
Other fur animals	Nov. 20–Feb. 15.

Prohibited methods: Unlawful to use poison except within curtilage around home. Traps must be stamped with name and address of owner and visited once daily. Traps set in open must be properly safeguarded.

Licenses: Resident, $5.25 (county of residence); $10.25 (county other than county of residence); $25.25 (state-wide license). Nonresident, $25.50 (county). Alien $50 (special, issued by commissioner). Not required of resident Confederate veterans entitled to Florida pension, nor of children under 15. Issued by county judge. Written permission of owner required to trap on inclosed lands of another. Fur dealer: Resident, $10; nonresident, $100; issued by State game commissioner. Reports required of licensed trappers and fur dealers.

Possession and sale: Skins legally taken may be possessed, bought, and sold during open season and for 30 days thereafter.

FLORIDA—Continued

Shipment and export: Skins legally taken may be shipped and exported during open season and for 30 days thereafter.[26]

Propagation: No legislation.

Bounties: None paid.

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[25] *Florida:* Animals destructive of crops, game, fowl, or stock may be killed on own property at any time under permit from State game commissioner.

[26] Does not apply to manufactured furs or fur dealers

GEORGIA

Open seasons:[27]	*Dates inclusive*
Beaver, mink, otter, bear, muskrat, raccoon	Nov. 20–Feb. 29.
Fox (red, gray)	Sept. 1–Jan. 31.
Other fur animals	No close season.

Prohibited methods: Fox dens protected during close season. Fox, skunk, or wildcat may not be taken by trap, deadfall, or similar device.

Licenses: Resident, $3; nonresident, $25; issued by commissioner or county warden. Permission of owner required to trap on lands of another.

Possession and sale: Prohibited during close season. Unlawful to purchase or accept furs from person who at the time is not the holder of a valid State trapping license. Dealers must make such reports as may be required by commission.

Shipment and export: Transportation company may not accept furs for shipment unless shipper exhibits his trapping license or dealer's certificate. Packages for shipment must be marked with number and kind of hides contained therein.

Propagation: Permit from commissioner required to possess fur animals for propagation.

Bounties: None paid.

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[27] *Georgia:* Fur animals destroying property may be killed at any time.

HAWAII

Hawaii has no wild animals valuable for fur. There are no restrictions on the propagation of fur animals except that mongooses and rabbits may not be kept or bred. Pet rabbits may be raised if kept in confinement.

IDAHO[28]

Open seasons:[29]	*Dates inclusive*
Beaver	No open season.[30]
Marten, fisher, otter, mink, raccoon, fox, muskrat (see exception)	Dec. 1–Mar. 1.
Exception: Muskrat in Bear Lake and Caribou Counties	Mar. 1–Apr. 13.
Other fur and predatory animals	No close season.[29]

Prohibited methods: Unlawful to destroy houses, dams, or other structures erected by fur animals.

Licenses: Resident, $5; nonresident, $25; alien, $50; issued by warden, deputy, or authorized agent. Licensed trapper must make verified report at end of season of number and kind of fur caught, where sold, and the price received. Unlawful to destroy, disturb, or remove traps of licensed trapper.

Possession and sale:[30] Skins of animals legally taken, within or without State, may be possessed or sold at any time. Unlawful to possess fur animals, or the hides thereof, on which there is no open season in the State, without permit from State game warden.

Shipment and export: No restrictions.

Miscellaneous: Unlawful to use flesh of any game animal, bird, or fish for trap bait. Unlawful to destroy houses, dams, or other structures erected by fur animals, except under permit of State warden.

IDAHO—Continued

Propagation: Permit from State warden required. Permittee must make verified yearly report showing number of animals kept in captivity, number sold, and number on hand.

Bounties: None paid.

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[28] *Idaho:* State fish and game warden may close season in any locality on any species of fur-bearing animal threatened with extinction. Under permit of State warden, persons may protect their own premises from depredations of fur animals, except that bears doing damage may be destroyed without a permit.

[29] All trapping is prohibited on State game preserves, except that certain predatory animals may be killed thereon by deputy game wardens and persons authorized by State game warden.

[30] State game warden may grant permits to take beavers when doing damage to irrigation canals, crops, etc., or authorize deputy warden or State trapper to take such animals. Pelts of animals taken must be turned over to warden for sale. Possession of beaver hides otherwise prohibited.

ILLINOIS

Open seasons:[31]	*Dates inclusive*
Otter, raccoon, skunk, opossum, fox in northern zone	Nov. 1–Feb. 15.
In central zone	Nov. 15–Feb. 1.
In southern zone	Nov. 15–Jan. 15.
Muskrat, mink, in northern zone	Nov. 1–Mar. 1.
In central zone	Nov. 15–Mar. 1.
In southern zone	Nov. 15–Feb. 15.
Other fur animals	No close season.

Prohibited methods: Houses, dens, and den trees, of fur animals protected, except otter and muskrat dens which obstruct public or private ditches or watercourses. Unlawful to use spear or similar device for hunting or taking fur-bearing animals, or explosives, chemicals, or mechanical devices or smokers of any kind to drive them out of their burrows, dens, or houses. Use of automobile or vehicle propelled by mechanical power, or the lights thereof, or ferret, weasel, guinea pig, or rat, in hunting or taking fur-bearing animals prohibited.

Licenses: Resident citizen, $1; nonresident citizen, $10.50; issued by county, city, or village clerk. License not required of landowners and tenants and members of families to trap during open season on the lands on which they reside. License not issued to a person under 16 years of age without written consent of parent or guardian, nor to alien. Licensee, on or before April 15, must report all hides of fur animals taken, sold, shipped, or dealt in, together with names and addresses of persons to whom sold or shipped. Permission from owner, agent, or occupant required to trap on land of another.

Fur buyer, $10; wholesale fur buyer, $50. Issued by department of conservation. Buyer must keep daily register of all furs purchased.

Possession and sale: Possession of green hides (hides which have not been tanned) of fur animals permitted in each zone during the open season and 10 days thereafter. No other restrictions on possession and sale.

Shipment and export: No restrictions on skins legally taken and possessed.

Propagation: Permit required to conduct a fur farm on which protected animals are reared; fee $2. Permit to breed and raise ferrets, fee, $10.

Bounties: None paid by State; counties may pay bounty on groundhog and crow.

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[31] *Illinois: Northern zone* comprises Henderson, Warren, Knox, Peoria, Woodford, Livingston, and Iroquois Counties and all counties north thereof. *Southern zone* comprises Madison, Bond, Fayette, Effingham, Jasper, and Crawford Counties and all counties south thereof. *Central zone* comprises all counties not included in the northern or southern zones.

INDIANA

Open seasons:[32]

	Dates inclusive
Raccoon, fox, opossum, skunk, mink, muskrat	Nov. 10–Feb. 10.
Beaver, otter	No open season.

Prohibited methods: Traps set on land of another must be placed at least 18 inches within burrow or hollow log and must be visited at least once in each 36 hours. Muskrat houses protected except when obstructing ditches or watercourses. Unlawful to dig out fur-bearing animals or to chase them from their burrows by use of smoke, fumes, or chemicals.

Licenses: Resident, $1; nonresident, $15.50; issued by clerk circuit court and by superintendent of fisheries and game and his agents. Honorably discharged soldiers, sailors, and marines who are resident citizens of State may trap during open season without license; also resident landowners, children living with them, and tenants, may trap without license on lands occupied by them. Written consent of owner, occupant, or lessee required to trap on land of another.

Possession and sale: Possession of fur animals or green hides prohibited during close season, except that fresh skins may be disposed of during first five days of close season.

Shipment and export: No restrictions on skins legally taken and possessed.

Propagation: All animals raised in captivity are considered domestic stock, and the owner may possess, sell, ship, transport, or otherwise dispose of them without regard to laws regulating the killing and disposition of wild animals. Fur animals, lawfully acquired, may be possessed for breeding purposes during close season. An inspection certificate, fee $5, must be obtained from the department of conservation. Permit required to possess or harbor ferrets; fees, $10 for each single ferret and $5 for each additional one; issued by conservation department.

Bounties: Boards of county commissioners may pay bounty on wolf, fox, groundhog, crow, owl, or hawk.

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[32] *Indiana:* Protected fur animals may be killed at any time on one's own premises to protect property. The destruction of such animals, however, must be reported to the department of conservation within five days, and if hides are preserved, they must be sent to the department or arrangements made for their disposition.

IOWA

Open seasons:[33]

	Dates inclusive
Beaver, mink, otter	Nov. 15–Mar. 15.
Raccoon, skunk	Nov. 1–Jan. 31.
Muskrat (see exception)	Nov. 15–Mar. 15.
Exception: On, or within half mile of, meandered lake or stream	No open season.
Other fur animals	No close season.

Prohibited methods: Use of poison prohibited; skunk dens and muskrat houses may not be injured or destroyed.

Licenses: Hunting license required to trap: Resident, $1; nonresident or resident alien, $10; issued by county recorder. License not issued to persons under 18 years of age without written consent of parent or guardian. Owners of farmlands, their children, and tenants may trap on own land without license during open season. Permission of owner, occupant, or agent required to hunt or trap fur animals on cultivated or inclosed land of another.

Possession and sale: Skins of fur animals and parts thereof lawfully taken, within or without State, may be possessed and sold during the open season and 10 days thereafter, or at any time on proof of lawful possession, or upon filing an affidavit with the auditor of the county in which possessed, giving an inventory of such skins and stating when taken or from whom acquired and the location of premises where retained; provided that green hides in process of manufacture may be possessed at any time.

Shipment and export: Skins of protected fur animals legally taken may be exported during open season and first 10 days of close season.

IOWA—Continued

Propagation: Breeder's permit, fee $2, must be obtained from State game warden to propagate protected fur animals.

Bounties: Boards of supervisors of counties may allow bounty on crow, groundhog, pocket gopher, or rattlesnake.

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[33] *Iowa:* Fur animals may be destroyed at any time to protect public or private property.

KANSAS

Open seasons:[34]

	Dates inclusive
Muskrat, skunk, mink, opossum, and raccoon	Nov. 16–Jan. 31.[35]
Beaver, otter	No open season.

Prohibited methods: Ferrets, poisons, or use of smoke guns or other devices for forcing smoke, gas, or liquids into holes, dens, or runways, prohibited. Unlawful to destroy houses, dens, or runways of fur aniamls. Unlawful to set or maintain more than 30 traps, which must be visited daily.[35]

Licenses: Resident, $1, issued by county clerk; nonresident, $15, issued by secretary of state. Resident landowner and members of his family may hunt or trap on own land during open season without license. Trapping license not issued to alien. Consent of owner or lessee required to hunt or kill wild animals on land of another. Fur dealer, $10; required to keep open records and file report of each purchase of furs.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken. May not be shipped except during open season and 10 days thereafter, but licensed dealers may make shipments out of season under special permits.

Propagation: Quadrupeds raised in wholly inclosed preserve under license (fee, $2) may be sold at any time for breeding or stocking purposes. Shipments must be tagged to show number and kind of animals, number of breeder's license, and names and addresses of consignor and consignee, and be accompanied by permits from State warden. Licensee required to make annual report of number of animals in possession. Wild animals may be captured during open season and thereafter had in possession for breeding purposes, under rules and regulations of State warden.

Bounties; Coyote, $1; wolf, $5; crow, pocket gopher, 10 cents each; jack rabbit, 5 cents each: crow eggs, 1 cent each; paid by county.

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[34] *Kansas:* Kansas forestry, fish, and game commission may further restrict seasons and methods of taking.

[35] Owner or legal occupant of land may destroy these animals at any time when they are destroying poultry or damaging other property.

KENTUCKY

Open seasons:[36]

	Dates inclusive
Beaver, mink, raccoon, fox, otter, opossum, skunk	Nov. 15–Dec. 31.[37]
Other fur animals	No close season.

Prohibited methods: Traps must be set 18 inches or more within a hole, cave, or hollow log, and must be visited within each 36 hours.

Licenses: Resident, $1; nonresident, $25. Issued by county clerk. Written consent of owner or lessee required to trap on lands of another.

Possession and sale: Possession of green skins during close season prima facie evidence of unlawful taking.

Shipment and export: No restrictions on skins legally taken.

Propagation: No legislation.

Bounties: None paid.

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[36] *Kentucky;* Fur animals may be killed at any time on one's premises to protect property.

[37] Raccoon, opossum, skunk, and mink may also be taken with gun or dog from Oct. 1 to Feb. 15.

LOUISIANA

Open seasons:[38]	*Dates inclusive*
Bear[39]	Oct. 15–Jan. 5.
Muskrat, mink, otter, raccoon, skunk, opossum, fox, weasel, alligator (except alligator in coast parishes and Orleans, St. Charles, St. John, and St. James, no close season)	Nov. 20–Feb. 5.[40]
Beaver	No open season.
Wolf, wildcat, cougar, coyote	No close season.[41]

Prohibited methods: Unlawful to trap bear or fox at any time, or wolf, wildcat, or cougar from February 6 to November 19; use of firearms for other fur animals prohibited. Gigs, spears, pitchforks, or like devices, and explosives, chemicals, mechanical devices, or smokers to drive fur animals from dens or houses prohibited. Unlawful to destroy muskrat houses and nests, lairs, or dens of other fur animals or to set traps within 10 feet thereof.

Bag limits: One bear a day, five a season.

Licenses:[41] Resident (trapping only; authorizes not more than 250 traps in parish where holder traps), $2; issued by tax collector. Traps must be visited daily. Trapping licenses not issued to nonresidents. Resident fur buyer, $10; resident dealer, $50; nonresident buyer, $50; nonresident dealer, $250; issued by department of conservation. Hunting license required to take bear, fox, wolf, wildcat, or cougar: Nonresident, $50; resident, $1. Licensed trapper within 15 days after close of season must report to department of conservation the number and kind of animals taken under license.

Possession and sale: Possession of raw or undressed furs prohibited from March 1 to November 19. Unlawful to possess raw furs without a license. Dealer must file sworn monthly statement of kind and number of pelts bought in State, and showing pelts shipped out of State.

Shipment and export: Tax, otter, 25 cents; mink, raccoon, 5 cents; alligators, 1 to 3 cents; and all other pelts, 1 cent each, must be paid on all pelts taken before being shipped out of State. All shipments must bear tags furnished by commissioner; no furs nor alligator skins may be shipped out of State except by holder of a dealer's license or by a trapper shipping his own catch; export of bear prohibited, except under written permission of the commissioner. Dealer must make sworn monthly report of pelts shipped out of State.

Propagation: Fur animals raised in captivity under license (fee, $10) may be sold at any time for stocking or breeding purposes, but may not be killed and pelted except during the open season. Fur animals for breeding purposes may not be captured except under restrictions specified in permits issued by department of conservation. Permit from the department is required to import wild quadrupeds into the State or to export from the State.

Bounties: None paid.

MAINE

Open seasons:[42]	*Dates inclusive*
Beaver	No open season.[43]
Muskrat (see exception)	Nov. 1–May 14.[43] [44]
Exception: In Androscoggin, Cumberland, York, Sagadahoc, Kennebec, Lincoln, Waldo, and Knox Counties	Dec. 1–Apr. 30.
Fox (see exception)	Oct. 16–Feb. 14
Exception: In Androscoggin, Cumberland, York, Sagadahoc, Kennebec, Lincoln, Waldo, and Knox Counties	Nov. 1–Feb. 14.
Bear, bobcat, Canada lynx (loup cervier), weasel	No close season.
Other fur animals	Nov. 1–Feb. 14.[43] [45]

Prohibited methods: Unlawful to use snare, swivel, pivot, or set gun, or to put out poison for any animals. Traps may not be set within 25 feet of a muskrat or beaver house. Unlawful to dig out a fox den or remove foxes therefrom, except in private fox ranches; or to set traps (except "water sets") within a half mile of compact or built-up portion of a city or village outside of own land or within 1 mile of cultivated land or pasture in any organized or incorporated place without consent of owner or occupant. A bear trap must be inclosed in a "hut," or surrounded with two strands of barbed wire, 5 yards distant from the trap, 4 and 5 feet, respectively, from the ground. Unlawful to disturb muskrat or beaver houses.

Licenses: Trapping, $5 (in organized township); $10 (State). License does not include beaver, and is not required for bobcat or Canada lynx. Not required of minors under 16, nor of residents or members of immediate family to trap on own cultivated land (except for beaver) in organized township. Issued by commissioner. Licensee, on or before December 31 of each year, must make such report as the commissioner may require. Written consent of the owner or occupant must be obtained before setting traps on the cultivated lands of another in an organized or incorporated place; such traps must be visited at least once in every 24 hours and any animals caught removed. Traps must be stamped or bear metal tag to show full name and address of trapper.

Special beaver-trapping license, good only in territory opened to beaver trapping by commissioner, fee, $25.

Dealer in skins must be licensed (fee, State, $25; county, $2), and must keep a record of transactions and forward same to the commissioner of inland fisheries and game on or before December 20 of each year.

Possession and sale: Sale of beaver skins without seal of commissioner attached prohibited. No other restrictions on skins legally taken.

Shipment and export: Transportation of beaver skins without seal of commissioner attached prohibited. No other restrictions on skins legally taken.

Propagation: Permit required to raise fur animals (fee, $2). No animals may be imported into the State without permit.

Bounties: Bobcat and Canada lynx (loup cervier), $10 each; paid by State; claim to be made within five days after killing or return from trip on which killing was done. Hedgehog, or porcupine (Maine forestry district October 15–April 1 only, paid by State), 25 cents, paid by town treasurer.

MARYLAND

Open seasons:	*Dates inclusive*
Otter, muskrat	Jan. 1–Mar. 15.[40]
Raccoon, opossum	Nov. 1–Feb. 1.
Other fur animals	No close season.[46] [47]

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[38] *Louisiana:* Unlawful to take young of any fur animal the pelt of which has no regular market value.

[39] Bears may be killed at any time on one's own land when actually damaging property.

[40] Muskrats may be killed at any time when damaging any levee, and, under permit of department of conservation, to prevent damage to cultivated or pasture land; any fur animal may be killed by the owner of land upon which it is destroying property.

[41] Wolves and wildcats hunted for sport may be taken in any manner at any time and may be possessed by the lawful holder of a State hunting license.

[42] *Maine:* Any person may lawfully kill any wild animal, except beaver, found destroying his property.

[43] Special laws on fur-bearing animals in certain localities. For detailed information apply to Commissioner of Inland Fisheries and Game, Augusta.

[44] Upon complaint of any water company that beavers or muskrats are polluting waters, or of any landowner that beavers are doing actual substantial damage to his property, commissioner of inland fisheries and game may declare special open season upon such waters and lands. (See "Licenses.")

[45] Raccoons and skunks may be hunted at night, Oct. 1–Dec. 15, in Androscoggin, Cumberland, Kennebec, Sagadahoc, York, Knox, Lincoln, Waldo, and Oxford Counties.

MARYLAND—Continued

Prohibited methods: Unlawful to take or kill muskrat in any manner, except by trapping; to dig for muskrat or in any manner molest or destroy any part of a muskrat house or den. Unlawful to hunt raccoon or opossum between sunrise and sunset, or to cut tree for catching or killing raccoon or opossum without consent of owner; use of steel traps or similar devices for catching raccoon or opossum prohibited.

Licenses: Hunting license required to trap: Resident, State, $5.25; county, $1.25; nonresident, $15.50 (fee $5.50 for State license if applicant owns real estate in Maryland assessed at $500; $1.50 for county license in county where such real estate is located); issued by clerk of circuit court—in Baltimore City by clerk of court of common pleas. Licensee required to wear tag displayed on middle of back and to carry license on person. License not issued to persons under 14 years of age without written request of parent or guardian. Owners, tenants, and their children may hunt on own land during open season without license.

Possession and sale: Possession of green hides of otter or muskrat prohibited except from January 1 to March 25. Cured skins legally taken may be possessed at any time for business purposes.

Unlawful to buy, sell, or expose for sale, or transport from any fox or fox hide in Baltimore County.

Shipment and export: No restrictions on skins legally taken and possessed.

Propagation: No legislation.

Bounties: A State bounty of 50 cents each on sharp-shinned and Cooper hawks killed in State, paid from State game-protection fund.

MASSACHUSETTS

Open seasons:	*Dates inclusive*
Mink, otter, muskrat, skunk, raccoon (see exceptions)	Nov. 1–Mar. 1.
Exceptions: Raccoon may also be hunted with dog and gun during October.	
In Dukes and Nantucket Counties	No close season.
Other fur animals	No close season.

Prohibited methods: Unlawful to open, disturb, or destroy muskrat house or to set trap within 10 feet thereof. Traps must be marked legibly with owner's name and must be removed at end of open season. Poison may not be used to kill animals, except rats, woodchucks, or other pests on one's own premises. The use of steel traps with spread of over 6 inches and "choke" traps with greater opening than 6 inches is unlawful, as is also the use of snares or, except by landowner, of scented baits. Except as otherwise stated, fur animals may only be taken by shooting or trapping.

Bag limits: Twenty-five raccoons a season.

Licenses: Nonresident citizen, $5.25. Nonresident residing in a State affording similar privileges to residents of Massachusetts, who owns real estate assessed at not less than $500, or who is a member of a hunting or fishing club or association incorporated prior to 1907, or who is a guest on written invitation of an incorporated club or association for hunting foxes, $2.25. Alien, $15.25 (applicant must have resided in State 10 days and own real estate therein to the assessed value of $500).

Resident citizen, $2.25 (not issued to minors under 18; and those between ages of 12 and 18, on written application and consent of parents or guardians, may obtain trapping license, fee, 75 cents, in discretion of issuing officer). Resident may trap during open season without license on land owned or leased on which he is actually domiciled and which is used exclusively for agricultural purposes, and not for club, shooting, or fishing purposes. Duplicate of lost or destroyed license, fee, 50 cents. Licenses issued by city and town clerks.

Licensee, during month of January, must make written report of number of fur animals trapped during preceding year.

Written consent of owner required to trap on improved or posted land of another. Traps must be visited at least once in 24 hours. Animals may be removed from traps on Sunday, but traps may not be set or reset on such day.

Possession and sale: No restrictions on skins legally taken during open season.

Shipment and export: No restrictions on skins legally taken during open season.

Miscellaneous: Introduction of fox or raccoon in Dukes County prohibited.

Propagation: May be permitted under regulations of division of fisheries and game.

Bounties: Seal, $2 (by Commonwealth); wild cat or lynx, $10; paid by town, but refunded by county.

MICHIGAN

Open seasons: [48]	*Dates inclusive*
Beaver, otter, fisher, marten, muskrat, raccoon	No open season.[48]
Mink, Lower Peninsula	Nov. 15–Dec. 31. Mar. 1–Mar. 15.
Upper Peninsula	Nov. 15–Dec. 31. Mar. 15–Mar. 31.
Bear	Nov. 15–Nov. 30.
Skunk	Nov. 15–Jan. 31.
Wolf, coyote, fox, lynx, wildcat	No close season.

Prohibited methods: Unlawful to trap bear, or to use spears, baited hooks, explosives, chemicals, mechanical devices, or smokers to drive animals from their holes or homes; or to destroy, disturb, or molest any beaver, skunk, or muskrat houses or holes.

Bag limits: One bear a season.

Licenses: Resident, $1.25; nonresident, $10; issued by county clerk. A hunting license also permits the holder to trap fur-bearing animals during open season except bear, for which a big-game license is required. Big-game license required to take bears: Nonresident, $50; resident, $2.50. Resident citizens and their minor children under 17 years of age may hunt or trap during open season on own inclosed lands upon which they live without a license. License to hunt or trap on other lands issued to minors over 12 and under 17 on application of parents or guardian, but such licensed minors while hunting or trapping must be accompanied by parent or guardian. Alien prohibited from hunting or taking any wild animals in State.

Possession and sale: Possession of the carcass or skin of fur animals killed in close season prohibited.

Shipment and export: No restrictions on skins legally taken, possessed, or tagged.

Propagation: Annual license (fee, $5) required to engage in raising fur animals. Live animals and skins of animals raised in captivity must be tagged (fee, 5 cents for each tag).

Bounties: None paid.

MINNESOTA

Open seasons: [49]	*Dates inclusive*
Fisher, skunk	Nov. 15–Mar. 1.
Beaver,[50] otter, raccoon	No open season.
Muskrat [51]	Mar. 1, 1928.
Bear, mink, weasel, wolf, wildcat, lynx, fox	No close season.

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[46] *Maryland:* Unlawful to trap or shoot muskrats, otters, or mink on lands of another in Dorchester County without permission of owner.

[47] Unlawful to shoot or kill any fox in Cecil and Kent Counties while it is being pursued by dogs. Unlawful to trap foxes in Baltimore County.

[48] *Michigan:* Season on beaver, otter, fisher, and marten closed until 1930. Fur animals, except beaver, may be destroyed under permit from director, on one's own premises to protect property, but hides must be properly cared for and turned over to director at expiration of permit. Unlawful to trap on State game preserves or to trap badger in and within 2 miles of any city public park containing more than 200 acres, of which 150 acres or more is woodland.

MINNESOTA—Continued

Prohibited methods: Use of poison prohibited, except as permitted by commissioner. Unlawful to molest or destroy muskrat or beaver house, den, dam, or abiding place; to hunt these animals with dogs; or to take muskrats in any manner except by trapping, but muskrat houses must not be destroyed in placing traps therein. Unlawful to dig out or take red-fox cubs from dens. Black bears may not be taken by use of steel traps, except under permit of commissioner.

Licenses: Issued to resident only: Fee, $1; by county auditors; not required of persons under 14 years of age; commissioner may issue license (fee, $1; bond, $500) to trap a specified number of beavers at a designated time and place; licensee must report the taking of beaver within 15 days and obtain tag from commissioner, fee, $1.50. Licensed trapper required to make report within 30 days after his license expires, showing number of each kind of fur animal taken thereunder. Owners, lessees, or members of their immediate families may trap without license during open season on own or leased land occupied by them as a permanent residence. Unlawful to enter growing grain for purposes of killing any wild animal without permission of owner. Buyer: Resident, local, $1; traveling, $10; nonresident, $25; wholesale, $1. Applicant for fur-buyer's license must furnish $1,000 bond. Buyers must make reports.

Possession and sale: Skins of beaver legally taken, when tagged (fee, $1.50), and skins of other fur animals legally taken if tagged within five days after close of season, may be possessed, bought, or sold at any time. Possession in close season without tags prohibited.

Shipment and export: Skins of beaver legally taken, when tagged (fee, $1.50), and other skins legally taken may be transported at any time. Export of red-fox cubs taken in State prohibited. Package or receptacle containing wild animals or parts thereof when transported by a common carrier must have attached a proper coupon tag bearing signature, address, and license number of shipper, together with number and kind of animals or parts thereof contained therein or if shipped by owner or occupant of land a signed statement that "The contents of this package were taken from animals killed on my land."

Propagation: Annual license (fee $3 for 10 acres or less, 15 cents an acre for additional lands) from commissioner of game and fish required to operate a fur farm. Muskrat or beaver farm must be inclosed with animal-proof fence. Beavers or muskrats on area at time of inclosure must be purchased from commissioner by licensee at $2.50 each for beavers and 50 cents each for muskrats. Pelts of animals from fur farms must be tagged (fee 1 cent each) before being sold or transported. Trespassing on licensed fur farm prohibited. Licensee must make annual report.

Bounties: Wolf, $15; cub wolf, $6; paid by State. County or town boards may offer bounty on wolf, gopher, ground squirrel, groundhog, rattlesnake, crow, or blackbird.

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[49] *Minnesota:* Wild animals other than beavers causing injury to property may be taken at any time under permit of commissioner, who may also issue permits to take unprotected animals on game refuges.

[50] A limited number of beavers may be taken under a special license from commissioner. (See "Licenses.")

[51] Under regulations commissioner may permit taking of muskrats in shallow lakes or sloughs when it may be shown they are in immediate danger of freezing or starvation. Open season will be fixed by regulation. Communicate with commissioner of game and fish, St. Paul.

MISSISSIPPI

Open seasons:	*Dates inclusive*
Bear	Nov. 1–Feb. 28.
Otter, mink, muskrat, skunk, raccoon,[52] opossum,[52] weasel (trapping)	Dec. 1–Feb. 1.[53]
Beaver, fox [52]	No open season.
Wildcat	No close season.

MISSISSIPPI—Continued

Prohibited methods: Unlawful to trap bear, to remove a fox from the ground or a tree in any manner, or needlessly to destroy beaver houses or dams. Fur animals protected when driven from their natural habitat by high water or fire. Trapping devices must be inspected and contents removed every 36 hours.

Bag limits: One bear a season.

Licenses: Nonresident, $500 (county); resident, $10 (county); issued by sheriff. License not required to trap or hunt fur animals during open season on land owned or leased by resident. Written permission required to trap on posted land of another.

Possession and sale: No restrictions on skins legally taken during open season and first five days of close season.

Shipment and export: Shipment or export of green hides of fur animals prohibited except during the open season and five days thereafter.

Propagation: Muskrats raised on licensed preserve for commercial purposes, may be trapped thereon by proprietor December 1 to February 29. Fur animals raised on licensed preserve may be bought or sold and shipped within or out of State for propagation.

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[52] *Mississippi:* Raccoon may be hunted Nov. 15 to Feb. 1, and opossum Oct. 1 to Jan. 15; foxes may be chased or hunted with hounds only from Aug. 1 to Mar. 1.

[53] Mink, skunk, opossum, or weasel when doing damage may be trapped at any time by owners or tenants on own holdings or by officers of the law.

MISSOURI

Open seasons:	*Dates inclusive*
All fur animals	Dec. 1–Jan. 31.[54]

Prohibited methods: Use of poison or smoke device in taking any protected animal prohibited.

Licenses: Hunting license required to trap: Resident, State, $2.50; county, $1 (good in county of residence or adjoining county); issued by county clerk or license collector. Nonresident or alien, $10. Fur dealer, $5. Issued by commissioner. Written permission required to trap on inclosed premises of another.

Possession and sale: Possession and sale of green pelts prohibited during close season, but dry pelts may be possessed and sold during open season and first 10 days of close season.

Shipment and export: Shipper must show hunting license to transportation company. Furs taken out of season may not be possessed for any purpose. Dried pelts may be shipped during first 10 days of close season. Shipments must be marked with the name and address of shipper, his license number, date of shipment, and nature of contents.

Propagation: Permits to capture fur animals for propagating purposes may be obtained from State game and fish commissioner; fee, $5; breeder's permit fee, $5.

Bounties: None paid.

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[54] *Missouri:* Fur animals may be destroyed at any time and in any way by person residing on own land to protect premises from depredations, but pelts of animals so killed may be marketed in season only.

MONTANA

Open seasons:[55]	*Dates inclusive*
Fisher, muskrat,[56] mink, fox	Dec. 1–Apr. 15.
Beaver,[57] marten or sable, otter, raccoon [58]	No open season.
Other fur and predatory animals	No close season.

Prohibited methods: Unlawful to capture or kill any fur animal from an automobile or by aid or use of a set-gun, jack or other artificial light, or dog. Beaver and muskrat houses protected from injury.

MONTANA—Continued

Licenses: Trapping license, $10 (issued only to holder of a $2 resident general hunting license); special permit required to trap beavers on own land when doing damage or to export their skins; special license (trapping on State game preserves), $5; issued by State game warden. Trapping license not required of minors between the ages of 14 and 18 years who hold resident general hunting licenses. Taxidermist, $15.

Possession and sale: Sale and shipment of beaver skins, whether taken within or coming from without State, prohibited, except that skins legally taken under permit and tagged may be shipped or sold within State or they may be exported under permit from the State game warden. Beaver skins coming from without State must be reported and forwarded to State warden within three days after arrival in State for tagging (fee 50 cents for each tag) and then may be bought and sold, or exported under shipping permit (fee 50 cents). No other restrictions on skins legally taken.

Shipment and export: (See "Possession and sale" and footnote [57].) No restrictions on skins legally taken, possessed, or tagged. Permit required to ship out furs; packages must be marked to show contents. Package containing beaver skins offered for transportation must be marked to show names and addresses of consignor and consignee, number of skins, and number of shipping permit.

Propagation: Fur-farm license, $5. Permit for sale of live beavers trapped in State, $3 each animal; sale restricted to holders of fur-farm licenses.

Bounties: The livestock commission may make regulations governing the payment of bounties.

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[55] *Montana:* Commission may create fur-bearing animal districts and restrict or prohibit trapping therein.

[56] Muskrats doing damage may be taken under permit of commission, except that permit is not required from June 1 to Aug. 31.

[57] Unlawful to kill beavers except when doing damage to own land, under a special permit from the State game warden (fee, $10), for which application must be filed between May 1 and Nov. 30. Permits expire May 1, and skins must be reported and tagged by July 1. All skins of animals so taken must be properly cured and forwarded to the State game warden, Helena, to be tagged with a numbered metal tag (fee, 50 cents for each tag). Tagged skins may be sold or shipped within State, but a shipping permit (fee, 50 cents) must be attached to each shipment sent out of the State.

[58] Season closed on marten or sable, otter, and raccoon until opened by commission.

NEBRASKA

Open seasons: [59]	*Dates inclusive*
Muskrat, otter, mink, fox	Nov. 16–Mar. 1.
Raccoon, opossum	Nov. 1–Feb. 15.
Beaver	Nov. 1–Jan. 31.[60]
Other fur animals	No close season.

Prohibited methods: Unlawful to use spear or like device in hunting or taking fur animals, or explosives, chemicals, mechanical devices, or smokers of any kind, or ferrets to drive fur animals from holes, dens, or houses. Unlawful to disturb or destroy den or house of fur animal except of muskrat or otter obstructing a public or private ditch or watercourse; unlawful to cut down or into any tree containing a den.

Licenses: Resident, $2.10; nonresident or alien, $25.10; buyers, $1; issued by State department of agriculture and authorized vendors.

Possession and sale: Possession of green hides prohibited, except during open season and 30 days thereafter. Beaver skins coming from without the State, upon being inspected and stamped by State warden, may be possessed and sold at any time. No other restrictions on skins legally taken.

NEBRASKA—Continued

Shipment and export: Green hides may be transported by express, baggage, or mail during open season and 30 days thereafter, if package is labeled (in two places) with name of consignor, number of his trapping license, and number and kind of hides. No other restrictions on skins legally taken.

Propagation: Fur animals raised in captivity under $2 breeding license may be sold alive and transported for breeding purposes, and the skins, when tagged and labeled with name of licensee, number of license, and kind and number of skins may be sold and transported at any time.

Bounties: Wolf, coyote, mountain lion, $2 each; wildcat, $1; ground squirrel, pocket gopher, crow, magpie, 10 cents each. Paid by county.

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[59] *Nebraska:* Fur animals, except beavers, may be taken at any time necessary for the protection of property.

[60] Beavers damaging property may be killed on own land from Aug. 1 to Oct. 31, and under a permit from chief game warden may be killed at any time, but such killings must be reported to State department of agriculture.

NEVADA

Open seasons:	*Dates inclusive*
Beaver,[61] otter	Jan. 1, 1930.
Bear, raccoon, marten, fisher, mink, skunk, fox	Nov. 15–Mar. 15.

Prohibited methods: Unlawful to take fur animals in any manner except by trap or gun, to dig out or drive skunks from dens by use of chemicals, or to molest or destroy any muskrat nest.

Licenses: Hunting license required: Resident citizen, $1.50; nonresident citizen, $10; Issued by county clerk, State fish and game warden or his deputies. License not required of minors under 14, nor of persons trapping on own land.

Possession and sale: Unlawful to posses beaver or other skins unless it can be shown that they were legally taken. No other restrictions.

Shipment and export: No restrictions on skins legally taken.

Propagation: Game or fur animals (except beaver) raised in a licensed preserve (fee, $10) may be sold or shipped at any time under invoice.

Bounties: Mountain lion, $5; lynx or wildcat, $2, paid by county. Counties pay bounty of 1½ cents each for pocket gophers when at least 100 heads are presented at one time.

The State board of livestock commissioners is authorized to pay bounty from funds derived from tax on horses, cattle, and hogs. The reward for coyote, coyote pup, wildcat, or lynx is 75 cents each; for mountain lion, $5.

The State board of sheep commissioners is authorized to pay bounty from funds derived from tax on sheep, the payments being the same as those made by board of livestock commissioners.

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[61] *Nevada:* Beavers doing damage to property may be trapped under authorization from board of county commissioners. Furs of animals so taken must be preserved and turned over to board for sale, half of proceeds to be returned to trapper. Other fur animals injuring property may be killed in any manner at any time.

NEW HAMPSHIRE

Open seasons: [62]	*Dates inclusive*
Marten or sable, otter, fisher, mink, muskrat, skunk, fox [63] (see exception)	Nov. 1–Feb. 29.
Exception: In Carroll, Coos, and Grafton Counties	Oct. 10–Feb. 29.
Raccoon (see exception)	Nov. 1–Dec. 31.[63]
Exception: In Carroll, Coos, and Grafton Counties	Oct. 10–Dec. 31.
Beaver	No open season.
Other fur animals	No close season.

Prohibited methods: Bear traps must be safeguarded in a substantial manner. Use of poison or set guns or snares is prohibited. Unlawful to destroy house, den, or burrow of any fur animal or to set a trap in or at entrance of a muskrat house.

NEW HAMPSHIRE—Continued

Licenses: Resident, $2.15; nonresident, $25.15; issued by commissioner or agents. Resident fur dealer: $25 (State); one or more counties, each county $3; issued by fish and game commissioner. Fur dealers must keep records and furnish copy to commissioner during January of each year. Persons selling or shipping furs outside State other than through resident buyer must keep same records and make same reports as fur dealers. License not required of resident landowners and their minor children to trap on own farmlands during open season nor of children under 16. No person may trap on lands of which he is not owner or lessee without written permission of owner. All metal traps must be legibly marked or stamped with the trapper's name, and must be visited at least once every 24 hours. Unlawful to take traps of another or to remove fur animals from them. Trappers are liable for any damage to domestic animals by traps.

Possession and sale: Possession of fur animals permitted only during open season, but skins legally taken may be bought or sold at any time. Nonresident dealers may purchase furs from licensed resident dealers.

Shipment and export: No restrictions on skins legally taken and possessed.

Miscellaneous: Unlawful to tear down or destroy any fence or wall, leave open any gate or bar, or trample or destroy any crop on land of another while trapping or pursuing wild animals.

Propagation: Permit (fee, $2) required to propagate fur animals, game, or fish.

Bounties: Bear, $5; hedgehog, 20 cents; wildcat, $10; paid by fish and game department.

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[62] *New Hampshire:* Fur or predatory animals may be killed at any time when destroying domestic animals or fowls.

[63] Raccoons and foxes may also be taken by use of dog and gun during month of October.

NEW JERSEY

Open seasons:	*Dates inclusive*
Skunk, mink, muskrat,[64] otter	Nov. 15–Mar. 15.
Raccoon	Oct. 1–Dec. 15.
Beaver	No open season.
Other fur animals	No close season.[65]

Prohibited methods: Muskrat, skunk, mink, and otter may be taken by trap only. Unlawful at any time to disturb the lodge or nesting chamber of muskrat. Raccoons may not be trapped, but may be hunted with dogs and firearms, without permit, from sunset to sunrise in season.

Licenses: Hunting and fishing license required to trap: Nonresident, $10.50; resident, $1.65. Issued by county, city, or town clerk, salaried wardens, or registrars of licenses. (After January 1, 1928, licensee must wear license button.) Resident minors under 14 may trap without license. Occupant and immediate members of his family residing on farm may trap thereon without license during open season.

Possession and sale: Possession of raccoon permitted during open season and 10 days thereafter, except they may be possessed at any time under a breeder's license, but skins legally taken may be possessed and sold at any time. Possession of live fox prohibited except by permission of board of fish and game commissioners.

Shipment and export: Export of raccoon prohibited, except by nonresident licensee, or holder of breeder's license, but pelts of raccoon legally taken may be exported at any time. No other restrictions on skins legally taken or possessed.

Miscellaneous: Unlawful to molest trap set by another or to take animal caught in such trap. Unlawful to liberate fox in State.

Propagation: Raccoons may be raised or kept in captivity under breeder's license; no other restrictions except those imposed by close seasons, during which fur animals may not be taken for breeding purposes.

NEW JERSEY—Continued

Bounties: Fox, $3; woodchuck, amount, not exceeding 50 cents, fixed by boards of chosen freeholders; paid by counties.

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[64] *New Jersey:* Muskrats may be killed at any time by owner of canal or dam which they are destroying.

[65] Foxes may be hunted with hounds and firearms in daylight from Nov. 10 to Apr. 30, except during open season for deer (Dec. 17 to 21). Killing of fox must be reported to commissioners or county warden within 48 hours.

NEW MEXICO

Open seasons:	*Dates inclusive*
Beaver	No open season.[66]
Bear	Oct. 10–Oct. 31.[66]
All other fur animals	Unprotected.

Prohibited methods: No restrictions.

Bag limits: One bear a season.

Licenses: Big-game license required to take bears. Nonresident: General, $35.25; game, $30.25; big game, $25.25. Resident: General, $5; game, $4.50; big game, $3. Issued by county clerks and deputy wardens. Alien resident of State or an adjoining State not permitted to hunt or to own or possess shotgun or rifle in State.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: Export permit for bear required (fee, $1.25). No restrictions on skins legally taken.

Propagation: Permit from State game warden required.

Bounties: None paid by State.

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[66] *New Mexico:* When destroying property beavers and bears may be killed under permit from State game and fish warden. Skins of beavers so taken must be turned over to State warden for disposition, half of proceeds going to permittee.

NEW YORK

Open seasons:	*Dates inclusive*
Bear	Oct. 15–Nov. 15.
Mink, sable	Nov. 10–Mar. 15.
Skunk	Nov. 10–Feb. 10.[67]
Muskrat (see exception)	Dec. 1–Mar. 31.
Exception: In Clinton, Essex, Franklin, Hamilton, Jefferson, Lewis, St. Lawrence, Warren, Washington, and that portion of Herkimer County north of the towns of Ohio and Russia	Dec. 1–Apr. 20.
Raccoon (in Orleans County, no open season)	Nov. 10–Feb. 10.
Beaver	No open season.[68]
Otter, fisher, fox	No close season.

Prohibited methods: Use of chemicals, gas, or other poisonous substances prohibited. Skunks may not be taken by the aid of dogs or by digging out or driving them from dens or holes by smoking. Unlawful to kill muskrats by shooting, except they may be taken with a 22-caliber rifle in the counties bordering upon Lake Champlain; to take them in box, wire, or cage traps; or to molest, injure, or disturb muskrat houses or dens. Raccoons may not be taken from dens or houses, or by cutting den trees.

Bag limits: One bear a season.

Licenses: Resident, $1.25; nonresident, $10.50; issued by county, city, town, or village clerks. Owners or lessees and members of immediate families actually occupying cultivated farmlands may trap fur animals thereon without license during open season. Minors under 16 may trap fur animals without a license. Indian resident or member of Six Nations residing on reservation wholly or partly within State fee, $1.25. Only licensed Indians residing on a reservation may take fur animals thereon. Alien not permitted to hunt or kill wild animals except under special license from the conservation commission, or to own or possess shotgun or rifle.

NEW YORK—Continued

Possession and sale: Fur animals may be possessed during open season only, but hides of fur animals legally taken and possessed may be bought or sold at any time.

Shipment and export: Shipment and export prohibited, except hides of fur animals legally taken and possessed may be transported at any time.

Miscellaneous: Traps used for taking fur animals protected by law may not be staked or set during close season.

Propagation: Protected fur animals may be kept alive in captivity for propagation and sale, under license from the conservation commission (fee, $5), No fur-bearing animals may be kept, which are taken wild during close season for such animals (unless taken under license); nor may they be disposed of during close season except for propagation. The conservation commission is authorized to issue license to capture animals for propagation: Fee for permit, $1. License to breed. sell, or possess ferrets, fee, $10.

Bounties: None paid.

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[67] *New York:* If injuring property, skunks may be taken at any time and in any manner, but the skins of animals so taken shall not be possessed, sold, bought, or trafficked in.

[68] In sections of State designated by conservation commission beavers may be trapped from Mar. 1 to Mar. 31.

NORTH CAROLINA

Open seasons:[69]	*Dates inclusive*
Bear	Oct. 1–Jan. 15.
Beaver	No open season.
Raccoon, opossum	Oct. 1–Jan. 31.
Mink, otter, skunk	Nov. 1–Feb. 15.
Muskrat	Dec. 1–Mar. 31.
Fox, wildcat	No close season.

Prohibited methods: Unlawful to set steel trap for bear. Use of poison or artificial light prohibited.

Licenses: Hunting license required for trapping; resident, $1.25; nonresident, $15.25; issued by clerks of superior courts, wardens, and deputies. Resident landowner and dependents under 21 years and lessees may trap on own or leased lands without license. Minor under 16 resident of State may trap under license of parent or guardian, and nonresident minor child of resident may obtain resident license when visiting parent. Raw fur buyers or dealers whose business exceeds $1,500 per annum required to pay license tax ($50) annually to State, and counties, cities, and towns in which they do business may charge license tax not exceeding one-half State tax. Peddlers or itinerant buyers or traveling dealers required to pay license ($100) annually to State and $50 annually to each county in which they do business. Does not apply to those who hunt or trap animals from which pelts are taken, or who buy from licensed dealers and do not maintain a place of business in State.

Possession and sale: Skins of fur animals lawfully taken may be bought, sold, and possessed at any time.

Shipment and export: No restrictions on skins lawfully taken.

Propagation: Fur animals may be taken for propagation under permit (fee $1) of director, department of conservation and development.

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[69] *North Carolina:* Animals committing depredations may be taken at any time.

NORTH DAKOTA

Open seasons:[70]	*Dates inclusive*
Mink, weasel, raccoon, fox	Nov. 1–Mar. 31.
Muskrat	Dec. 15–Feb. 15.
Skunk, badger	Oct. 1–Feb. 28.
Beaver, otter	No open season.[71]
Other fur animals	No close season.

NORTH DAKOTA—Continued

Prohibited methods: Unlawful to cut into, molest, destroy, or dynamite any beaver dam or beaver or muskrat house or mound, or to shoot or spear muskrats.

Licenses: Resident, $2; nonresident, $25; issued by commissioners, deputies, and county auditors. License not required of person under 16 or of resident or members of family residing permanently with him to trap on own cultivated land, during open season. Fur dealers: Nonresident buyer or shipper or agent, $50; resident shipper or buyer, $5 for each place of business in State; resident traveling agent, buyer, or shipper, $15; issued by game and fish commission. Unlawful to trap muskrats on posted lands of another. Aliens prohibited from hunting, taking, or killing any wild animal, except in defense of person or property.

Possession and sale: Skins of fur animals legally killed may be possessed or sold during open season and first 10 days of close season. Possession and sale during close season allowed under permit.

Shipment and export: Shipment and export prohibited except under permit and tag. Owners, tenants, and minors under 16 shipping furs trapped on own premises without license must mark package with name and address and number and kind of furs shipped. Report required annually of dealers of furs bought, sold, or shipped.

Propagation: The State game and fish board issues permits (fee, $5) to breed and domesticate fox, mink, muskrat, skunk, and raccoon, and also permits to sell or ship them when raised in captivity. Under permit from board and $500 bond, such fur animals may be taken at any time for breeding purposes. Annual reports are required of licensed breeders.

Bounties: Adult wolf or coyote, $3; pups, $1.50 each.

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[70] *North Dakota:* Fur animals (except beaver) may be killed at any time to protect one's own property.

[71] Beavers doing damage may be taken by bonded deputies or agents of commission, but skins or live animals so taken are property of the commission.

OHIO

Open seasons:[72]	*Dates inclusive*
Raccoon,[73] fox, skunk, opossum (see exception)	Nov. 15–Feb. 1.
Exception: Columbiana, Mahoning, Trumbull, Ashtabula, Geauga, Portage, Summit, Stark, and Cuyahoga Counties	Nov. 1–Jan. 15.
Mink	Nov. 15–Mar. 1.
Muskrat, in Lake Erie trapping district	Dec. 1–Mar. 15.[74]
In inland trapping district	Nov. 15–Mar. 1.[74]
Other fur animals	No close season.

Prohibited methods: Unlawful to dig out or destroy the house, den, or burrow of fur animals or to smoke or drown the animals therefrom. Unlawful to spear muskrats, or to take a raccoon from its den.

Licenses: Resident, $1.25; nonresident, $15; issued by county and township clerks. Alien prohibited from hunting or trapping. License not required of owners, managers, tenants, or their children to trap during open season on own land. Written permission from owners or authorized agents required to trap on lands of another.

Possession and sale: Possession of fur animals during close season prohibited, but skins legally taken may be possessed or sold at any time. Raccoons legally taken may be possessed alive in inclosures as pets.

Shipment and export: Shipment and export prohibited, except that skins legally taken may be transported at any time. Packages containing fur animals or parts thereof when transported by common carrier must be marked to show contents, initial point of billing, and names and addresses of consignor and consignee.

Propagation: No restrictions, except those which prevent capture of wild stock in close season.

OHIO—Continued

Bounties: Townships pay a bounty of $1 each on certain hawks and the great horned owl, and 25 cents on crows.

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[72] *Ohio;* Protected fur animals, when damaging property, may be destroyed by owners or tenants of land (except on Sunday). Skins may not be removed from animals so taken.

[73] Raccoons may not be taken except from 6 p. m. to 6 a. m. and at field trials.

[74] "Lake Erie trapping district" includes Lake Erie and waters, lands, and marshes adjacent to or within 10 miles thereof; "inland" district includes balance of State.

OKLAHOMA

Open seasons:[75]	*Dates inclusive*
Beaver, otter, mink, marten, or sable	No open season.
Bear (see exception)	No close season.
Exception; In Blaine, Caddo, Commanche, Kiowa, and Major Counties	No open season.
Raccoon, fox, opossum, skunk, muskrat, civet cat, badger	Dec. 1–Jan. 31.[76]

Prohibited methods: Use of traps (other than smooth-jawed single-spring steel trap having spread of not more than 4 inches), snare, deadfall, or other device, prohibited. Traps must be visited once in 24 hours. Unlawful to set trap in the open, or in path, road, or runway of domestic animals or dogs.

Licenses: Trapping license issued only to holder of hunting license. Resident citizen, $1.25 (not to exceed 10 traps); professional trapper, $50 (required of resident citizen using more than 10 traps); nonresident, $250. Issued by warden, deputy, or county clerk. Licensed trappers required to report within 30 days after expiration of license all pelts taken, sold, or shipped, with names and addresses of persons to whom disposed of. Trapping license not issued to person under 14, nor to person under 16 without consent of parent or guardian. License not required of resident landowners, tenants, or their children to trap on land owned or occupied by them. Written consent of owner required to trap on occupied lands of another. Fur buyer, $3; wholesale fur buyer, $25; issued by State game warden. All licensed fur buyers required to keep daily records and render monthly reports.

Possession and sale: Unlawful to sell or possess pelts of fur animals except during open season and first 10 days of close season.

Shipment and export: No restriction during open season and first 10 days of close season on skins lawfully taken or acquired.

Propagation: State game warden issues permits to propagate fur-bearing animals (fee, $2, together with fees for tagging). Licensed breeders may sell and transport animals raised in preserves under rules prescribed by warden.

Bounties: County commissioners are authorized to offer bounty on gray wolves or coyotes ($5), and may also pay bounty of not exceeding 5 cents each on crows, English sparrows, hawks, rabbits, prairie dogs, pocket gophers, and ground squirrels.

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[75] *Oklahoma:* Fur-bearing animals may be killed at any time when found actually destroying livestock or poultry.

[76] Raccoons and foxes may be chased with dogs for sport July 1–Feb. 29.

OREGON

Open seasons:[77]	*Dates inclusive*
Beaver, west of Cascades (except in Coos, Curry, Jackson, and Josephine Counties, and east of a line through town of Scottsburg in Douglas County, and south of Portland-Astoria highway in Clatsop and Columbia Counties, no open season); east of Cascades in Crook, Deschutes, Jefferson, Klamath, and Lake Counties only	Dec. 1–Feb. 29.[78]
Mink, otter, fisher, marten, muskrat, raccoon	Nov. 1–Feb. 28.[78]
Bear in Jackson, Josephine, and Klamath Counties—no close season elsewhere	Nov. 1–Nov. 30.
Other fur animals	No close season.

Prohibited methods: Unlawful to destroy muskrat house, except where it obstructs ditch or watercourse.

Licenses: Fee, $2; issued by State game commission. License not required for trapping on own land. Special beaver trapping license, fee, $2. Fur dealer, $3. Licensee must keep chronological record showing number and kind of furs purchased, and names and addresses of persons from whom obtained, and make verified annual report to commission. Unlawful for unnaturalized persons to hunt or trap without gun license ($25) and hunting license. Unlawful to remove or disturb traps of a licensed trapper on public domain or on land where he has permission to trap. Licensed trappers are required to make verified annual reports of number of animals caught; receipts for fur, and where sold.

Possession and sale: Possession and sale prohibited, except that animals or hides legally taken within or without State may be possessed or sold at any time.

Shipment and export: Shipment and export prohibited, except that skins of animals legally taken may be shipped at any time.

Miscellaneous: Unlawful to use flesh of game bird or animal for trap bait.

Propagation: Permit (fee, $2) to keep fur-bearing animals may be obtained from State game commission. No wild fur animals may be taken for propagating purposes in close season nor may those held in captivity under permit be sold in that season. Yearly reports to the commission are required.

Bounties: State game commission is empowered to pay bounties on any predatory animal in order to protect game; under this act it now pays $25 each for wolf and cougar.

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[77] *Oregon:* Unlawful to hunt or trap fur animals on State game preserve.

[78] Unlawful to trap beavers in national forests. Beavers doing damage may be killed on own or leased property, but such killing must be reported in writing to the commission; hides of beavers so killed are the property of person killing them; other fur animals damaging property may be killed under permit of State game warden, but skins of animals so taken must be delivered to State game commission for disposition.

PENNSYLVANIA

Open seasons:[79]	*Dates inclusive*
Bear[80] (over 1 year old)	Nov. 16–Dec. 15.
Raccoon	Nov. 1–Jan. 15.
Muskrat, skunk, mink, otter, opossum	Nov. 1–Feb. 29.
Fox, wildcat, weasel	No close season.[81]
Beaver	No open season.

Prohibited methods: Unlawful to take bears with steel trap, deadfall, or pen, or to shoot them except with a single bullet, but the use of steel-jacketed bullets is prohibited. Steel traps having a spread of jaws greater than 6½ inches may not be used for trapping fur animals or vermin. All traps must bear metal tag showing name and address of owner, must be visited once in every 36 hours, and at end of open season must be taken up or sprung. Unlawful to dig out fur animals; to drive them from holes or dens by use of smoke, explosives, or chemicals; to cut den trees; or to take fur animals by use of poison. Beaver houses and dams are protected, except under special permit. Unlawful to disturb traps of another or to remove fur animals therefrom.

Bag limits: One bear a season, or four to a camp or body of men.

Licenses: Nonresident, $15; issued by commission or county treasurer. Resident, $2.15 (fee of 15 cents extra to justice of peace); issued by county

PENNSYLVANIA—Continued

Licenses—Continued. treasurer. Minors under 16 may trap fur animals and vermin without a license. Licensee required to wear tag on middle of back. Resident citizen, members of family, and regularly hired help, residing on and cultivating land may hunt on such land, and, with consent of owner, on adjoining land without a license, during open season. Alien not permitted to hunt or kill any wild animal in State, except in defense of person or property. Trapper must report to board of game commissioners number of each kind of fur animals killed. Fur dealer, $1.

Possession and sale: Bears may be possessed only during open season and first 30 days of close season. Bear and raccoon skins taken during open season may be possessed or sold at any time. Raw skins may be possessed during the open season and the first 15 days of close season.

Shipment and export: Skins of raccoons legally taken may be shipped or exported at any time. Packages must be plainly marked to show contents, name and address of owner, and county in which taken. Shipment by parcel post prohibited. Nonresident licensee may take out one bear legally killed. No other restrictions on skins legally taken and possessed.

Propagation: No restrictions on raising fur animals, except that possession and breeding of ferrets is unlawful except under license from State board of game commissioners. Fee for license to breed and sell ferrets, $25; to possess a ferret without breeding, $1.

Bounties: Wild cat, $15; gray fox, $4; red fox, $2; weasel, $1. Affidavit on form supplied by game commission must accompany entire unmutilated skin of animal when presenting claim to board of game commissioners at Harrisburg, Pa.

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[79] *Pennsylvania;* Fur animals may be killed or captured alive by landowners or tenants and their employees at any time to protect their growing crops.

[80] Bears may be killed at any time in defense of person or property.

[81] Under permit (no fee) from board, dogs may be used in hunting foxes and wildcats, Dec. 16 to Mar. 15.

RHODE ISLAND

Open seasons:[82]	*Dates inclusive*
Skunk	Nov. 1–Apr. 15.
Raccoon	Oct. 1–Feb. 1.
Muskrat, mink, otter	Nov. 1–Feb. 1.
Other fur animals	No close season.

Prohibited methods: Unlawful to set wire snares, or to use steel traps with teeth or with spread over 6 inches, or choke traps with greater openings than 6 inches. Traps must be concealed so as not to endanger domestic animals and must be visited at least once every 24 hours.

Licenses: Hunting license required for trapping: Resident, $1.25 ($2.25 on and after January 1, 1928); nonresident, $10.25; alien, $15.25; issued by town and city clerks. License not required of resident or his immediate family to hunt or trap on agricultural lands on which actually domiciled; nonresident owning real estate valued at not less than $500, and nonresident member of club incorporated for hunting or fishing purposes prior to January 1, 1909, which owns real estate assessed for taxation at value of not less than $1,000, may procure license at a fee of $1.25; nonresident guest of incorporated fox hunting club, $1.25 (authorizes fox hunting and is good for a period of 6 days); licenses not issued to minors under 15 years of age. Written permission required to trap on inclosed lands of another.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: No legislation.

Bounties: Fox, $5; crow and certain hawks and owls, 25 cents; paid by State.

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[82] *Rhode Island:* Landowner may kill fur animals on own land at any time.

SOUTH CAROLINA

Open seasons:	*Dates inclusive*
Mink, muskrat, otter, skunk, raccoon,[83] opossum, fox,[84] and other fur animals	Nov. 24–Mar. 1.[85]
Bear	No close season.

Prohibited methods: Hunting at night prohibited except for raccoon, opossum, or fox. Unlawful to shoot or trap foxes, to dig them out of the ground, or to push or drag them out of a tree or log. Unlawful to set, sell, make, or use a steel trap or any like device within the State.[86] Use of deadfall prohibited.

Licenses: Hunting license required: Resident, county license, $1.10; State, $3.10; issued by county game warden and his agents; nonresident, $15.25; issued by county game warden. No license required of resident owners, tenants, their children, or, under written permission, their employees to hunt during open season on own lands. Consent of owner or manager required to hunt or trap on lands of another.

Possession and sale: No restrictions on skins of fur animals legally taken.

Shipment and export: Skins of fur animals must be tagged by State warden or deputy before being shipped or transported. Tag fees: Otter, red, fox, $1; raccoon, gray fox, mink, 25 cents; skunk, 10 cents; opossum, muskrat, 5 cents. Packages containing furs for transportation must bear certificate of State warden or deputy that the tag required to be attached to each pelt has been properly attached and paid for. Persons, firms, or corporations shipping furs must make monthly report to county game warden of number of skins shipped or transported. Shipments must be labeled to show number and kind of skins in package and consignor and consignee. No other restrictions on skins of fur animals legally taken.

Propagation: No legislation.

Bounties: None paid.

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[83] *South Carolina:* Raccoons may be killed after July 15 by the owners of crops which they are destroying.

[84] Foxes doing damage may be shot on one's own premises at any time. Trapping foxes prohibited.

[85] Hunting season for raccoons, opossum, and fox, Sept. 1 to Mar. 1. Wildcats may be killed without license at any time by officers of the law and by landowners upon their own holdings.

[86] Steel traps may be set within 200 yards of residence, or 25 yards of poultry house for protection of property.

SOUTH DAKOTA

Open seasons:[87]	*Dates inclusive*
Mink,[88] muskrat, raccoon, opossum (see exception)	Dec. 1–Feb. 1.
Exception: Muskrat, east of Missouri River	No open season.
Skunk [88]	Oct. 16–Feb. 1.
Beaver,[89] otter, silver, black, or cross fox	No open season.
Other fur animals	No close season.

Prohibited methods: Unlawful to shoot or spear muskrats, or to destroy or molest muskrat houses, except that these may be opened without injury thereto for the purpose of placing traps therein during open season. No person may set or operate more than 75 traps at any one time.

Licenses: Resident, $5; nonresident, $25; issued by director of game and fish and county treasurer. Licenses not required of residents under 14, nor of landowners trapping on own lands during open season. Unlawful to hunt on cultivated or posted lands of another without permission of owner.

Possession and sale: Beaver skins must bear metal tag (fee, 50 cents) from director of game and fish. Unlawful to possess, buy, or sell raw skins of protected fur animals during close season, whether taken or killed within or without State.

Shipment and export: Permit from director of game and fish required to sell or ship beaver skins; unlawful to ship raw skins of protected fur animals during close season, whether taken or killed within or without State.

Propagation: Breeder's permit required to conduct a fur farm; fees, $1 for each silver, black, or cross fox, and $1 for each other kind of fur animal.

SOUTH DAKOTA—Continued

Bounties: None paid by State. A county may pay $50 for each grown wolf, $4 for each wolf (other than coyote or prairie wolf) less than 1 year old, $10 for each mountain lion, and $4 each for coyote or prairie wolf, fox, lynx, and bobcat.

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[87] *South Dakota:* Season opens at noon and closes at noon.

[88] Skunks and minks doing damage around buildings may be killed at any time, and, under permit from director of game and fish, muskrats, or beavers damaging irrigation ditches, embankments, or public highways may be taken at any time.

[89] Director of game and fish may authorize trapping of beavers on public lands or game preserves.

TENNESSEE

Open seasons:[90]	*Dates inclusive*
All fur animals (season opens and closes at noon) (see exceptions)	Nov. 15–Feb. 15.[91]
Exceptions: In Crockett,[92] Fayette, Hardeman,[92] Haywood,[92] Henderson, Henry, Lauderdale, Madison, and McNairy Counties	No open season.
In Coffee County	Oct. 15–Feb. 1.

Prohibited methods: Steel traps must be placed at least 12 inches within the entrance to a hole, cave, den, or hollow log. Use of snares and deadfalls prohibited.

Licenses: None required. Written consent required to trap on lands of another. Traps must be inspected within each 36 hours, and captured animals removed; does not apply to trapping wildcats in Lauderdale County.

Possession and sale: No restrictions.

Shipment and export: No restrictions.

Propagation: No legislation.

Bounties: Wolf or panther, $2 certificate issued by county court, amount to be applied on payment of taxes.

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[90] *Tennessee:* Trapping on State property, including lakes, prohibited.

[91] Fur animals may be taken on one's own land at any time.

[92] In Crockett, Hardeman, and Haywood Counties residents may hunt wild animals at night with dogs Nov. 1–Feb. 1, Oct. 15–Mar. 1, and Nov. 15–Feb. 14, respectively, and in Crockett County residents under 16 may trap wild animals with one legal device Nov. 1–Feb. 1. In Davidson County raccoons, opossums, skunks, and mink may be taken with gun or dog Oct. 1–Jan. 1. In Dickson County foxes, mink, and weasels unprotected on and after Jan. 1, 1928. In Madison and Robertson Counties, opossums Oct. 1–Jan. 1.

TEXAS

Open seasons:[93]	*Dates inclusive*
Bear	Nov. 16–Dec. 31.
Beaver, otter, fox (exception)	No open season.
Exception; Foxes, west of San Antonio and Cibola Rivers and western boundary of Guadalupe, Caldwell, Bastoff, Lee, Burleson, and Brazos Counties, Brazos River, and western boundary of Jack and Clay Counties (except in Hays, Milam, Williamson, and Young Counties, no open season)	No close season.
Muskrat (except in Cass County, no open season)	Nov. 15–Mar. 15.
Other fur animals (except in Cass County, no open season)	Nov. 14–Feb. 14.

Prohibited methods: Beds, nests, and breeding places of muskrats protected, and muskrats may only be taken by trapping, except on own land, where they may be taken at any time by any means. Headlight, hunting-lamp, or other artificial light prohibited. Unlawful to trap muskrats on posted or inclosed lands of another without consent of owner.

Bag limits: One bear a season.

TEXAS—Continued

Licenses: Resident, $1; nonresident or alien, $50. License not required of resident owners, tenants, and their children on own land. Consent of owner necessary to trap on inclosed land of another.

Possession and sale: Muskrat skins taken on lands of another may not be purchased on such lands except from the landowner or his authorized agent. Possession of beaver and otter skins in State or fox skins in closed area, for sale prohibited. No other restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken or obtained.

Propagation: Permit must be obtained from game, fish, and oyster commissioner to trap or transport wild animals for propagation.

Bounties: May be paid by commissioners of McCulloch, San Saba, Lampasas, Burnet, and Llano Counties on wolves, wild cats, and other predatory animals.

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[93] *Texas:* Trapping of wild animals prohibited in Limestone County.

UTAH

Open seasons:[94]	*Dates inclusive*
Bear	Sept. 1–May 1.[95]
Beaver,[96] otter	No open season.
Mink, muskrat,[97] marten, raccoon	Oct. 15–Dec. 15. Feb. 15–Apr. 1.
Other fur and predatory animals	No close season.

Prohibited methods: Use of silencer on gun and discharge of firearm from automobile or within 50 feet of a public highway prohibited. Traps may not be placed within 25 feet of muskrat house or den.

Licenses: Resident citizen, $5. Issued by State fish and game commissioner or deputy, county clerk, or deputy or authorized agent. Not issued to minors under 16. Unlawful to disturb or remove traps of licensed trappers on public domain or on lands where they have permission to trap. Aliens other than homesteaders are not permitted to hunt or trap.

Possession and sale: Skins of fur animals legally taken may be possessed and sold at any time, except that skins of beavers, which may be taken only when doing actual damage to property under permit of the commissioner, must be turned over to the commissioner to be sold by him. Possession of beaver skins prohibited, except by a permit holder, unless tagged by commissioner. Green pelt or carcass of fur animal may not be possessed except during open season and 15 days thereafter.

Shipment and export: Shipment and export of furs legally taken and possessed permitted at any time.[96] (See "Possession and sale.") Skins of beavers taken under permit of the commissioner may only be shipped by the permittee to the commissioner for sale. Shipment or export of beaver skins prohibited, unless such skins are tagged by the commissioner.

Miscellaneous: Use of flesh of game animals or birds as trap bait for fur animals prohibited.

Propagation: Permit (no fee) from commissioner required to propagate fur animals, but such animals held under permit may not be killed during close season.

Bounties: Wolf, $62.50; bear, mountain lion, cougar, $30; coyote, $4; lynx, bobcat, $3.

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[94] *Utah:* Commissioner may shorten or close season on fur animals, or further restrict the number that may be taken, where necessary to afford sufficient protection to any species.

[95] Dogs may be used in pursuit of bear, and bear destroying livestock may be killed at any time by cattle owners or their employees or Federal or State trappers.

[96] When beavers are destroying property, State fish and game commissioner may grant permit to trap them, but hides of animals so taken must be delivered to and sold by commissioner, who shall recompense for trapping in not more than half the proceeds from sales.

[97] Property owner may trap muskrats doing actual damage to dams, ditches, or watercourses in sufficient numbers to insure protection to such property.

VERMONT

Open seasons:[98]	*Dates inclusive*
Muskrat (see exceptions)	Oct. 25–Apr. 15.
Exceptions: On shores of Lake Champlain in Rutland County; Poultney River below Carvers Falls, and shores of Lake Memphremagog in Orleans County	Jan. 1–Apr 30.
Waters and shores of Lake Champlain in Addison and Chittenden Counties; Shelburne Pond and La Platte River in Shelburne; Hinesburg Pond (Lake Iroquois) in Hinesburg; banks and waters of East Creek, Dead Creek, Lemon Fair (Leicester River) or their tributaries, or Otter Creek in Addison County	Jan. 1–Apr. 19.
Mink (see exception), raccoon, fox (except Grand Isle County, no close season), otter (see exception) marten, fisher cat, skunk	Oct. 25–Feb. 15.[99]
Exception: Mink and otter, on shores of Lake Champlain in Rutland County; Poultney River below Carvers Falls; shores of Lake Memphremagog in Orleans County	Jan. 1–Apr. 30.
Beaver	No open season.

Prohibited methods: The use of set guns, snares, and poisons is prohibited; bear traps must be carefully safeguarded, and visited once in 48 hours. Unlawful to open or destroy a muskrat house or to place a trap therein or at its entrance. Unlawful to take skunks, raccoons, or foxes from holes or dens by cutting, digging, smoking or use of chemicals.

Licenses: Resident, $1; nonresident, $10.50; issued by town clerk. Owners of farmlands and their resident minor children or tenants may take fur animals on own lands during open season without a license. License not issued to persons under 16 without written consent of parents or guardians. Nonresident citizen owning improved real estate appraised at not less than $1,000 upon which he pays taxes, may obtain a resident license. Persons trapping on inclosed lands of another must, within 12 hours, inform owner of location and number of traps and must visit traps at least once in 24 hours.

Possession and sale: Possession of fur animals during close season prohibited, but the fur or skins of animals legally taken may be possessed, bought, or sold at any time.

Shipment and export: Packages containing fur animals or parts thereof delivered to a common carrier for transportation must be tagged to show number and kind of such animals or skins therein, names of consignor and consignee, station from which shipped, and destination. A person required to have a license must also show the number of his license on the shipping tag. No other restrictions on skins legally taken and possessed.

Propagation: State fish and game commissioner issues special permits for propagating fur and game animals (fee, $2 and expense of tagging). Animals bred on fur farms may be sold and transported alive at all times when bearing identification tags prescribed by commissioner.

Bounties: Towns pay $8 bounty on bay lynx or bobcat and $1 on rattlesnake.

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[98] *Vermont:* Fur animals may be killed at any time to protect one's own property, but such killing must be reported to commissioner within 84 hours and pelts held for official inspection. Disposition of pelts so taken prohibited except under certificate of commissioner.

[99] Otters, martens, fishers, raccoons, foxes, and skunks may be taken with dog and gun, Oct. 15–Feb. 15.

VIRGINIA

Open seasons:	*Dates inclusive*
All fur animals (see local laws)	Dec. 1–Mar. 31.[1]
Amelia, Brunswick, Charlotte, Chesterfield, Franklin, Lunenburg, Nottoway, Tazewell, and Washington Counties: All fur animals	Sept. 16–Mar.15.[2]
Albemarle, Amherst, Madison, Nelson, Orange, and Spotsylvania Counties: Fox (trap)	Nov. 1–Nov. 30.[2]
Charles City, Essex, James City, New Kent, Warwick, and York Counties: Muskrat	Dec. 15–Mar. 31.
Campbell, Culpeper, Henry, Pittsylvania, and Rappahannock Counties: Fox	Sept. 16–Mar. 15.
Charles City, Chesterfield, Henrico, James City, and New Kent Counties: Raccoon, opossum	Oct. 16–Mar. 15.
Fauquier and Loudoun Counties: Fox	Sept. 1–Mar. 31.[3]
Fluvanna and Goochland, Counties: Fox	Sept. 1–Mar. 1.
Madison and Orange Counties: Fox	Nov. 1–Nov. 30.[2]
Patrick County:	
Raccoon, opossum	Oct. 15–Mar. 14.
Gray fox	Sept. 15–Mar. 14.
Princess Anne County: Mink, muskrat, otter (for profit)	Nov. 1–Mar. 14.

Prohibited methods: Unlawful to take muskrat in tidewater sections of State from half hour after sunset to half hour before sunrise, except by traps.

Licenses: Hunting license required to trap: Nonresident, $10; alien, $20 (alien owner of real estate resident for five years, same as resident). Enlisted or commissioned personnel of Army, Navy, or Marines stationed in Virginia may obtain licenses for same fees as residents. Resident: State, $3; county of residence, $1. Ninety cents may be allowed on county license when exchanged for State license. Issued by clerks of circuit and corporation courts. License not required of residents to hunt foxes with hounds. Residents and nonresidents and their children may hunt on own land during open season without a license. Tenant, under written consent of owner or landlord, may hunt without license during open season on lands on which he resides. Written permission is required to trap or hunt on lands of another, except chasing foxes with hounds where chase begins on other lands, and except uninclosed mountain lands west of Blue Ridge, not used for cultivation, except in Giles, Bland, Bath, and Highland Counties.

Possession and sale: No restrictions on skins legally taken, except that sale of red or gray fox is prohibited during close season in Henry County.

Shipment and export: No restrictions on skins legally taken.

Propagation: License required (fee, $25) to raise game or fur animals.

Bounties: Weasel, $1; sharp-shinned and Cooper hawks, goshawk, great-horned owl, 50 cents each; crow (if killed April 1 to September 3 0), 15 cents each; paid by county clerk.

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[1] *Virginia:* Season applies to trapping on lands of another, which is lawful only with written permission of owner, which permission the trapper must have on his person when trapping. Landowner may trap or kill fur animals on his own land at any time.

[2] Unlawful to shoot foxes.

[3] Foxes may be taken at any time by owner or tenant of land to protect property in Fauquier and Loudoun Counties. Written permission of owner required to take foxes on lands of another.

WASHINGTON

Open seasons:[4]

Beaver	No open season.[5]
Bear and other fur animals (open season fixed by county game commissions).[6]	

Prohibited methods: No steel trap larger than No. 3 may be used unless a notice in the English language on a large placard is placed above the trap. Unlawful to take fur animals with a gun larger than 10 gauge, or to disturb or remove traps of a licensed trapper. Traps must be marked with the name and address of owner.

Licenses: Citizen, $5 (county); fur dealer, $10; issued by county auditor. License not required of landowners and leaseholders trapping on own premises, nor of minors under 16. Dealers required to make quarterly reports of transactions and trappers to make annual report of number and kind of animals taken.

Possession and sale: Carcass and pelt of bear lawfully taken may be sold at any time; beaver skins obtained without State, if inspected and tagged (tag, 10 cents) by supervisor of game and game fish, may be possessed or sold at any time. Other furs legally taken coming from without State may be possessed, sold, and transported, if reported to supervisor of game and game fish or county game commission, within three days after arrival, and tagged (tag, 25 cents).

Shipment and export: Carcass and pelt of bear and skins of other fur animals legally taken and possessed may be shipped at any time.

Propagation: Breeder's license (fee, $20; renewal, $10) required.

Bounties: Paid by State. Counties are permitted to pay bounties on mountain lion or cougar, lynx, or wildcat, coyote, timber wolf, bear, red squirrel, and in the Columbia River district on seal or sea lion. Hair seal, $3 (paid by State).

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[4] *Washington:* Communicate with county game commission at county seat, or supervisor of game and game fish, Box 384, Seattle. Bears may be killed at any time when destroying domestic animals, and fur animals may be trapped by landowners or tenants when destroying crops, domestic animals, or poultry.

[5] State supervisor of game and game fish may issue permits to take beaver in State.

[6] County game commission may remove or kill fur animals doing damage to property.

WEST VIRGINIA

Open seasons:[7]	*Dates inclusive*
Skunk	Dec. 1–Jan. 31.
Red fox, in Brooke, Cabell, Fayette, Harrison, Kanawha, Lewis, Mason, Mingo, Morgan, Pleasants, Putnam, Ritchie, Summers, Taylor, Upshur, Wetzel, Wirt, Wood, and Wyoming Counties	Dec. 1–Jan. 31.
In rest of State	Unprotected.
Raccoon, opossum	Nov. 1–Jan. 31.
Beaver, otter	No open season.[8]
Muskrat	Nov. 1–Feb. 29.
Other fur animals	Unprotected.

Prohibited methods: Unlawful to set a steel or spring bear trap on land of another. Unlawful to hunt wild animals, except those which take refuge in trees, with a spot or jack light or other artificial light, or to cut down any tree in which animals den or take refuge for the purpose of capturing such animals.

Licenses: Hunting license required to take raccoons, opossums, beavers, otters, and skunks: Resident, $1; nonresident, $15; issued by county clerk. Resident landowner, his resident children or tenants, may hunt or trap during open season on own land without a license. License not required of minors under 15. Express permission of owner or tenant required to set or maintain a snare or trap upon land of another. Licensee must wear tag.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: No restriction on possession or sale, but animals must not be taken for breeding purposes in close season except on lands owned or tenanted by the breeder.

Bounties: Wildcat, bobcat, or catamount, $2.50.

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[7] *West Virginia:* A landowner, his agent, or tenant may hunt or kill fur animals, except raccoons, opossums, muskrats, beavers, and otters, on his own lands at any time.

[8] Commission may open season on beavers and otters.

WISCONSIN

Open seasons:	*Dates inclusive*
Beaver,[9] marten, fisher	No open season.
Otter in Florence, Forest, Iron, Juneau, Price, Langlade, Oconto, Oneida, and Vilas Counties	Mar. 1–Mar. 31.
In rest of State	No open season.
Mink (see exceptions)	Jan. 1–Apr. 10.
Exceptions: In Calumet, Fond du Lac, Green Lake, Marathon, Marquette, Outagamie, Waupaca, Waushara, and Winnebago Counties	Oct. 25–Apr. 1.
In Marinette, Lincoln, Oneida, Forest, Florence, Shawano, and Langlade Counties	Jan. 1–Apr. 1.
In Grant, Vernon, Crawford (except in Freeman and Seneca Townships, no close season) and Richland Counties, and Horicon Marsh in Dodge County	No open season.
Muskrat (see exceptions)	Jan. 1–Apr. 10.
Exceptions; In Calumet, Fond du Lac, Green Lake, Marquette, Outagamie, Waushara, Waupaca, Marathon (except Pike Lake in towns of Reid and Elderon, and Mayflower Lake and Lake Go-Toit in town of Norrie, no open season), and Winnebago Counties	Oct. 25–Apr. 1.
In Marinette, Lincoln, Oneida, Forest, Florence, Shawano, and Langlade Counties	Jan. 1–Apr. 1.
In Grant, Vernon, Crawford (except in Freeman and Seneca Townships, Jan. 1–Apr. 10) and Richland Counties, and Horicon Marsh in Dodge County	No open season.
Skunk, in all counties south of north line of Buffalo, Trempealeau, Jackson, Wood, Portage, Waupaca, Outagamie, Brown, and Kewaunee Counties	Nov. 1–Jan. 31.
In rest of State	Oct. 15–Jan. 15.
Raccoon, in all counties south of north line of Buffalo, Trempealeau, Jackson, Wood, Portage, Waupaca, Outagamie, Brown, and Kewaunee Counties	Jan. 1–Jan. 31.
In rest of State	Jan. 1–Jan. 15.
Black bear and other fur animals	No close season.

WISCONSIN—Continued

Prohibited methods: Unlawful to take fur animals with the aid of spear, gun, or dog; to disturb or molest muskrat houses, beaver houses, or beaver dams, or to molest or disturb raccoon den trees.

Licenses: Resident, $1, issued by conservation commission or county clerks. Each trap must be tagged, fee 5 cents. Report required from licensed trapper on or before June 1 of each year. Nonresident not permitted to trap; alien not permitted to hunt. Written consent of owner or occupant required to trap minks or muskrats on agricultural lands of another.

Possession and sale: Possession of green skins of fur animals permitted only during open season and first five days of close season; possession prohibited of the skin of a mink or muskrat which shows that the animal has been shot or speared. No other restrictions on possession and sale of skins legally taken.

Shipment and export: Shipment of hides must be marked to show number and kinds of hides, name and address of shipper, and number of his trapping license.

Propagation: Under license and supervision of commissioner, beaver, muskrat, skunk, otter, mink, raccoon, fisher, or marten may be taken and transported for propagation within State. Special licenses required to conduct fur farms. Breeders have same rights in silver, silver-black and black foxes as domestic animals. Unlawful to trespass on posted fox farm.

Bounties: Wolf cub taken between March 1 and November 1, $4; mature wolf killed at any time, $30; fox, $2; paid by State. County boards may offer bounty on crow, hen hawk, pocket gopher, streaked gopher, groundhog or woodchuck, English sparrow, blackbird, or rattlesnake.

WYOMING

Open seasons:	*Dates inclusive*
Beaver	No open season.[10]
Otter, fisher, marten, mink, muskrat (see exception), fox, raccoon	Nov. 16–Apr. 30.
Exception; Muskrat in Big Horn, Campbell, Converse, Fremont, Goshen, Niobrara, Platte, Sheridan, Uinta, and Washakie Counties	No close season.
All other fur animals	No close season.

Prohibited methods: Unlawful to trap bears.

Licenses: Resident citizen, $10; nonresident citizen, $50. License not required of persons under 17, nor for trapping predatory animals. Permit for trapping in State game preserves and national forests fee, $1, issued by State game and fish commissioner. Employees of Federal Government do not require permit to trap predatory animals. For bear: Resident (hunting license), $2.50; nonresident, $25, limit, 3 bears; issued by commissioner. Dog license, $1 (required for each dog used in hunting bears or predatory animals in national forests). Permission of owner required to hunt or trap on inclosed lands of another.

Possession and sale: Skins of beavers killed when doing damage to real estate may be possessed when duly tagged by commissioner and affidavit is furnished the commissioner by owner of the real estate showing damage and number of beavers killed, and upon payment of 50 cents for each beaver tag.

Shipment and export: Beaver hides must be tagged by commissioner before being shipped or transported.

Miscellaneous: Use of flesh of game animals or birds as trap bait for predatory animals prohibited.

Propagation: Beavers may be taken for propagation under a $5 permit, but animals so taken must be kept three years before being killed or sold.

Bounties: None paid by State.

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[9] *Wisconsin:* If beavers damage property, they may be captured and removed under permit and direction of State conservation commission; skins of animals that are killed in taking must be delivered to conservation commission. Owners or lessees of dams, under permit of conservation commission, may destroy at any time muskrats to protect such dams or levees, but may not sell, barter, or give away skins of such animals killed during close season.

[10] *Wyoming:* If beavers damage real estate the owner thereof may kill them, but must furnish State game and fish commissioner with affidavit describing real estate and showing damage and number killed. Skins of animals so taken must be tagged immediately (fee, 50 cents each).

LAWS OF CANADA

ALBERTA

Open seasons:[11]	*Dates inclusive*
Fox[12]	Nov. 1–Mar. 1.
Mink, fisher, marten	Nov. 1–Mar. 31.[13]
Otter	Nov. 1–Apr. 30.
Muskrat (see exception)	Mar. 1–Apr. 30.
Exception: South of North Saskatchewan River	No open season.[14]
Beaver[13]	No open season.[14]
Other fur animals	No close season.

Prohibited methods: Unlawful to use poison for taking fur animals; or to destroy, partially destroy, or to leave open any muskrat or beaver house or beaver dam.

Licenses: Trapping: Resident, $2; nonresident, $50; issued by minister of agriculture. License not required of farmer, or member of his family while actually residing with him upon his farm. Consent of owner or occupant required to trap on inclosed or cultivated lands of another. Permits to trap on game or forest reserves may be granted under regulations of lieutenant governor in council. Taxidermist, $5. Dealer in furs and skins of protected animals at a specified place of business, or within one mile thereof: Resident of a city, $25; resident outside of a city, $10; nonresident, $100. Traveling license issued to holder of a dealer's license or his manager upon payment of fee of $15. Traveling buyer: Resident, $25; nonresident, $100. Nonresident buying wholesale from licensed dealers, $5 (good for 10 days only). Licensee must make semiannual reports to department of agriculture. License to sell skins by tender or auction, fee, $25. Issued by minister or agents.

Possession and sale: No restrictions on prime skins legally taken and possessed.

Shipment and export: Export of furs and skins prohibited except under permit from minister. No furs or skins on which royalty has not been paid may be exported, and a special permit from the minister is necessary to ship out unprime skins. Export of live wild foxes prohibited.

Propagation: Manager of fur farm required to make reports January 1 and July 1 of each year. Export of live animals from fur farms allowed only on permit from the minister of agriculture. Permit, with fees, required to export live muskrat, mink, fisher, marten, otter, or beaver, whether raised on a fur farm or otherwise (orders in council).

Bounties: Timber wolves, male, $10, female, $20. Prairie wolf taken between April 30 and September 1, $2.

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[11] *Alberta:* Lieutenant governor in council may change close season on fur animals.

[12] Unlawful to trap fox for export.

[13] Unlawful to destroy a beaver dam unless authorized to do so by lieutenant governor in council, who may also authorize the killing of beavers or other fur animals when such killing is deemed to be in the public interest.

[14] Lieutenant governor in council may declare open seasons locally on beavers and muskrats.

BRITISH COLUMBIA

Open seasons: [15]

Eastern district; [16]	*Dates inclusive*
Bear (except white or Kermodei bear)	Sept. 1–June 30.
Beaver, muskrat	Mar. 15–Apr. 30.
Other fur animals	Nov. 15–Apr. 30.
Western district: [16]	
Bear (except white or Kermodei bear)	Sept. 15–June 15
Beaver, in Prince Rupert, Skeena, and Mackenzie electoral districts and that part of Lillooet electoral district lying within the western district	Feb. 15–Mar. 31.
In rest of district	No open season.
Other fur animals (see exception)	Dec. 1–Mar. 31.
Exception: Muskrats on Vancouver Island	No open season.

Prohibited methods: Bears may not be trapped. Unlawful to poison fur animals except that farmers and poultrymen may protect own stock; to destroy muskrat or beaver houses, except under permit to prevent damage on diked or agricultural lands; or to hunt fur animals at night.

Bag limits: Two grizzly bears and three of any other species a season.

Licenses: Trapping: Resident, British subject, $10; nonresident or resident alien not permitted to trap; nonresident general hunting license, fee, $25, and additional fees of $15 to $25 for each bear killed. License not issued to boys under 18 without written consent of parent or guardian. Issued by provincial game warden or authorized agent. Licensee must wear badge. Permission of owner required to trap on inclosed, cleared, or cultivated land of another. Mainland trappers must register trap lines, and licensed trapper who first occupies a trap line not later than 15 days after the beginning of any open season for trapping is protected against other trappers. Unlawful to touch or interfere with traps set by a licensed trapper. License must be returned within two months after it expires, with a statement of number of fur animals of each kind taken. Fur dealer: Resident, $25 (does not apply to licensed trapper selling skins taken by himself); nonresident or his agent, $200. License required for each place of business. Fur dealer must make verified report every three months, showing number and kind of skins purchased and date of transactions. Taxidermist, $5; tanner, $5. Provincial game warden may grant free permit to buy furs at wholesale from licensed fur dealers or at public auction.

Possession and sale: Unlawful to sell pelts taken during close season or to possess unprime furs. Possession of pelts of fur animals allowed only during open season, and for two months thereafter (three months, north of fifty-second parallel), except under special permit from Provincial game warden. Royalties must be paid on all furs exported or shipped to a tanner within Province. Bears may be sold only during open season in eastern district.

Shipment and export: Export of pelts of fur animals allowed only under special permit of Provincial game warden. Packages must be prepared so that they may be easily opened for examination, or labeled with a full description of contents, and names and addresses of the consignor and consignee, and accompanied by export permit.

Propagation: A permit from the Provincial game warden is required to propagate fur-bearing animals or to take them for breeding purposes. Breeder must keep a record of transactions as to purchases and sale of stock, which record must be open to inspection of any game warden, and must make verified report to Provincial game warden on or before August 31. Live animals and birds may be exported only under permit; and a permit is required to take foxes or other fur animals in close season.

Bounties: Panther, $40; timber wolf, $25; coyote, $2 (if not less than one week old). (Rates fixed from time to time by lieutenant governor in council.)

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[15] *British Columbia;* Seasons on fur animals, fixed annually by lieutenant governor in council, may be obtained from provincial game warden, Victoria, British Columbia.

[16] *Western district* includes that portion of the Province west of summit of Cascades and south of Atlin electoral district. *Eastern district* includes rest of Province.

MANITOBA

Open seasons: [17]

North of fifty-third parallel—	*Dates inclusive*
Fisher or pekan, sable, marten, mink	Nov. 1–Mar. 31.
Otter	Nov. 1–Apr. 30.
Muskrat	Mar. 15–May 15.
Fox, lynx	Nov. 1–Feb. 29.
Beaver	No open season.
South of fifty-third parallel—	
Fisher or pekan, sable, marten, mink	Nov. 1–Mar. 31.
Otter, beaver [18]	No open season.
Muskrat	Mar. 15–Apr. 30.
Fox, lynx	No close season.

Prohibited methods: Use of poison or dog in taking or hunting fur animals is prohibited. Unlawful to shoot or spear muskrats or to destroy muskrat houses. Beaver houses and dams protected, except under permit to protect property.

Licenses: Trapping: Resident, $2; nonresident Canadian citizen, $50; nonresident alien, $200; issued by minister of agriculture and immigration. Permission of owner required to trap on cultivated or inclosed lands of another. Licensee must return his license and make a report during month of June, showing number of each kind of animals taken. Fur trading: Resident traveling fur buyer, $25; resident raw fur merchant, or dealer, $10; resident traveling agent, $10; issued by minister. Licensees are required to keep record and to make monthly reports of furs handled. Fur dressing and tanning, $10; issued by minister. Licensee must keep records and report to chief game guardian on or before 10th of each month the number of royalty pelts handled and name and address of person forwarding or delivering the skins. Royalties of varying amounts must be paid on undressed skins or pelts of fur animals, except those imported or ranch bred.

Possession and sale: Possession of unprime skins prohibited. Unlawful to purchase or sell skins of muskrats that have been speared or shot. Any person purchasing or acquiring pelts from a trapper must ascertain that he holds proper trapping permit and at the same time record his name and number of his permit. Unlawful to purchase, barter, or trade pelt of a fur animal taken during the close season (does not apply to imported skins). No other restrictions on skins legally taken.

Shipment and export: Export prohibited of unprime skins or skins on which royalty is payable unless such shipment is accompanied by a permit procured from minister and has attached a declaration of number and kinds of skins contained. Shipment or removal from Province

MANITOBA—Continued

Shipment and export—Continued prohibited except by express or mail. No other restrictions on skins legally taken. Export prohibited of live protected animals (except ranch-bred animals) except under permit from minister of agriculture and immigration (permit must accompany shipment to destination); fees, for black or silver fox, $100; for other fox, $15; for otter, $25; for beaver, $5; for mink, fisher, or marten, $1; for muskrats, $2 a dozen or fraction thereof.

Propagation: License (fee, $5) must be obtained from the minister to operate a fur farm. Licensee, on or before the first days of January and July, must make verified reports showing the number, species, age, and sex of the animals on hand, from whom procured, and the number which have died during previous six months, with cause of death.

Bounties: Timber wolf,[19] $5; other wolf, $2; half is refunded to municipality by provincial treasurer.

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[17] *Manitoba:* Lieutenant governor in council may shorten current open season on fur animals. Trapping in provincial game preserves prohibited, except in Nos. 14, 15, and 19.

[18] Game commissioner may take necessary steps to prevent beaver damage, but no beaver dams may be disturbed between Oct. 1 and Apr. 1.

[19] Poison may not be used to capture wolves for bounty.

NEW BRUNSWICK

Open seasons:	*Dates inclusive*
Otter, fisher, marten, sable	Nov. 1–Mar. 31.
Mink	Nov. 1–Feb. 29.
Fox	Oct. 1–Feb. 29.
Muskrat (see exception)	Mar. 25–May 1.
Exception: In Carleton, Gloucester, Kent, Madawaska, Northumberland, Restigouche, and Victoria Counties	Mar. 25–May 25.
Beaver	No open season.[20]
Other fur animals	No close season.

Prohibited methods: Unlawful to take fur animals by use of poisons, with aid of hounds, or with gun equipped with silencer; to dig out foxes from their homes or earth burrows; or to shoot muskrats.

Licenses: Trappers and fur dealers:[21] Persons domiciled in Province, $10; all other persons, $50. Trappers and fur dealers must furnish the minister with written declarations showing their names and addresses, location of warehouses, shops, posts, or caches where skins are to be stored and places from which skins will be shipped out of Province, and must make monthly reports of operations. Issued by minister of lands and mines. License is required to traffic in, cure, or tan skins: Resident, $10; nonresident or resident alien, $50; issued by minister. Special license (accompanied by necessary tags) to trap beavers at designated times may be issued by minister; fee, $5 for each animal.

Possession and sale: Possession prohibited of furs on which royalties, as fixed by lieutenant governor in council, have not been paid; possession of green skins or carcasses of protected fur animals in close season prohibited.

Shipment and export: Skins legally taken, possessed, tagged, and on which royalty has been paid, may be exported under permit from minister. Permit from minister required to export live fur animals.

Propagation: Permits to capture wild fur animals for propagation within Province may be obtained from minister, who fixes fee for such permit.

Bounties: Wildcat, $5.

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[20] *New Brunswick:* Expires Oct. 1, 1930.

[21] License requirements and other provisions of act do not apply to hunter or trapper who is a British subject domiciled and residing in Province, who actually hunts, provided he sells his furs to a person domiciled in the Province.

NORTHWEST TERRITORIES[22]

Open seasons:[23]	*Dates inclusive*
Mink, fisher, marten	Nov. 1–Mar. 14.
Otter, beaver, muskrat (see exception)	Oct. 1–May 14.
Exception: Muskrat, north of latitude 64°	Oct. 1–June 14.
Foxes	Nov. 15–Mar. 31.

Prohibited methods: Unlawful to use automatic rifles, shotguns, or poison in taking fur animals or to destroy or injure any muskrat or beaver house.

Licenses: Trapping: Resident, $2; nonresident British subject, $75; other nonresident, $150. Fur dealer and trader or trafficker in furs: Resident, $5; nonresident British subject, $150; nonresident not British subject, $300. Issued by director of Northwest Territories. License not required of native-born resident Indian, Eskimo, or half-breed. On or before July 1, licensed trapper must report to nearest game officer number of fur animals taken under license. (Permit of Commissioner, Royal Canadian Mounted Police, required to establish trading post.)

Possession and sale: Licensed trapper may sell or trade skins of animals he has legally taken. Possession of unlawful or low-grade furs prohibited. No restrictions on other skins legally taken.

Shipment and export: No restrictions on skins legally taken and possessed.

Propagation: Permits may be obtained to take fur animals for propagation.

Bounties: Timber wolf, $30 (skin must be surrendered).

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[22] *Northwest Territories* means the northwest territories formerly known as Rupert's Land and the Northwestern Territory (except such portions thereof as are included in the Provinces of Ontario, Quebec, Manitoba, Saskatchewan, and Alberta, and the Yukon Territory), together with all British territories and possessions in North America and all islands adjacent thereto not included within any Province, except the Colony of Newfoundland and its dependencies.

[23] Trapping prohibited on Victoria and Banks Islands and in Peel River, Yellowknife, Arctic Islands, and Slave River Preserves, which have been reserved as hunting and trapping grounds for native Indians, Eskimos, and half-breeds.

NOVA SCOTIA

Open seasons:[24]	*Dates inclusive*
Beaver, marten, fisher	No open season.
Bear, wolf, wildcat	No close season.
Other fur animals	Nov. 15–Jan. 31.

Prohibited methods: Unlawful to take any protected fur animal (unless under a permit) by use of poison; to damage or molest a beaver dam or house or a muskrat house or to set snare or trap within 25 feet of the latter.

Licenses: Trapping: None required of resident; nonresident, $50; issued by minister of lands and forests and municipal clerks. Fur buyers: Nonresident, $100; resident traveling buyer, $25; issued by minister of lands and forests. Fur buyer must keep record and make monthly report of number of skins bought or sold, together with names and addresses of parties from whom purchased or to whom sold. Royalties of varying amounts must be paid on all furs, except bear, wolf, and wildcat.

Possession and sale: Unlawful to possess or sell green hide of any beaver, fisher, or marten, or to possess green hide of any fur animal taken out of season. No other restrictions on skins legally taken.

Shipment and export: Unlawful to export skins of fur animals except under certificate of inspection and permit (fee, 50 cents) from a game inspector.

Propagation: Permits (fee, $1) to take wild animals may be obtained from the minister of lands and forests under such restrictions as he may prescribe. Unlawful to keep fur-bearing animals, except silver foxes, in captivity for

NOVA SCOTIA—Continued

Propagation—Continued. breeding purposes without a permit from minister of lands and forests; fee, $2 for each kind of animal kept, payable annually. Reports are required annually on December 31. Unlawful to trespass in inclosures for fur animals.

Bounties: None paid.

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[24] *Nova Scotia:* Fox, raccoon, skunk, weasel, or muskrat may be killed on one's own inclosed premises for the protection of private property.

ONTARIO

Open seasons:[25]	*Dates inclusive*
Mink, fisher, marten	Nov. 1–Mar. 31.
Raccoon	Nov. 1–Dec. 31.
Muskrat (see exception)	Apr. 1–May 21.
Exception: South of French and Mattawa Rivers	Mar. 1–Apr. 21.
Beaver, otter, north Canadian National Railway	Dec. 15–Mar. 31.[26]
South to French and Mattawa Rivers	Jan. 1–Feb. 20.[26]
South of French and Mattawa Rivers, including Manitoulin Island	No open season.
Other fur animals	Unprotected.

Prohibited methods: Unlawful to shoot or spear muskrat, to injure or destroy any muskrat or beaver house or beaver dam, or to set trap closer than 5 feet to a muskrat or beaver house.

Licenses: Trapping, $5 (issued to resident only); issued by department of game and fisheries. License not required of residents to take bear, wolf, or fox by means of gun or dog. Only resident Indians permitted to take beaver or otter. Farmers and their sons may trap on own land during open season without license. Fur dealers or traders: Resident British subject, $25 (store license), $100 (traveling fur buyer), $100 (wholesale license); resident, $1 (restricted—buying for personal use); alien or nonresident, $200; nonresident, $5 (buying from wholesalers); licensee must make reports monthly. Fur dressing and tanning, $10; licensee must keep records and make monthly reports.

Possession and sale: Possession of furs during close season and the sale of unprime skins prohibited, except under permit. Unlawful to have skins dressed, plucked, or treated in any way except under permit obtained upon payment of royalties.

Shipment and export: Export prohibited except under permit obtained upon payment of royalties. No other restrictions on skins legally taken, possessed, or tagged. Shipments must be made by express or parcel post and packages must be marked with a list of the contents and the names and addresses of consignor and consignee.

Propagation: A permit is required of breeders of game or fur animals. Licensed fur breeders may sell live animals or skins during open season upon payment of royalties. The minister may grant permits to take fur animals for propagating purposes during the close season.

Bounties: Adult wolf, $15; wolf pups under 3 months old, $5; paid by county, but provincial treasurer refunds 40 per cent to the county. Provincial treasurer pays entire bounty in unorganized counties.

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[25] *Ontario:* Fur animals may be destroyed in defense of property, but skins so taken may not be sold during close season except under permit from minister.

[26] Beavers and otters may be taken under permit by resident Indians only. Under special permit from minister, overseer, or other officer may take or kill beavers doing damage to roads or private property.

PRINCE EDWARD ISLAND

Open seasons:	*Dates inclusive*
Otter, marten, mink, muskrat, skunk, raccoon	Nov. 1–Mar. 31.
Beaver	No open season.[27]
Fox	Dec. 1–Jan. 31.
Other fur animals	Unprotected.

PRINCE EDWARD ISLAND—Continued

Prohibited methods: Unlawful to put out poisoned baits for fox or other animals. Beaver dams protected.

Licenses: Trapping: None required of resident; nonresident, $50; issued by secretary-treasurer of Province. The game warden may grant permits to take beaver and issue coupons (fee, $1 each) to tag skins of animals taken.

Possession and sale: Possession and sale during close season prohibited. Holders of permits may possess, buy, or sell beaver skins that have proper coupons attached.

Shipment and export: No restriction on animals legally taken, possessed, and tagged.

Propagation: Several special acts of provincial legislature regulate fox ranching on the island. The animals are assessed for taxation, ranches are protected from trespass under heavy penalties, and incomes from ranches are taxed.

Bounties: None paid.

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[27] *Prince Edward Island:* Beavers may be taken under special license. They may be destroyed by the owner of private property on which they are locating and building dams, and, under permits from game warden or lieutenant governor in council, their dams may be destroyed when necessary to prevent damage to property.

QUEBEC

Open seasons:	*Dates inclusive*
Bear	Aug. 20–June 30.
Muskrat (see exception)	Nov. 1–May 31.
Exception: South of fiftieth parallel	Mar. 15–Apr. 30.
Fox	Nov. 1–Feb. 29.
Beaver, otter	Dec. 15–Mar. 31
Other fur animals	Nov. 1–Mar. 31..

Prohibited methods: Use of poisons in taking fur animals prohibited.

Licenses: Fur dealers: Persons domiciled in Province, $25; all other persons, $100; issued by minister of fisheries and game. Fur dealers must furnish minister with written declarations showing their names and addresses, location of warehouses, shops, posts, or caches where skins are to be stored and places from which such furs will be shipped out of Province. This act does not apply to a hunter or trapper who actually hunts, if he is domiciled and resides in the Province and is a British subject.

Possession and sale: Persons engaged in buying selling, or taking fur animals must, on or before 10th of each month, make report to the minister. Unlawful to possess, buy, or sell skins of fur animals on which royalty has not been paid. No other restrictions on skins legally taken.

Shipment and export: Shipment and export prohibited, except of fur animals or furs on which royalties have been paid. Skins must be shipped open to view and each skin must be stamped to show royalty paid and be tagged as prescribed by, minister before being shipped in any manner. Packages must show names and addresses of consignor and consignee.

Propagation: Minister may grant permits to take animals alive for breeding purposes.

Bounties: Wolf, $15.

SASKATCHEWAN

Open seasons:[28]	*Dates inclusive*
Beaver	No open season.[30]
Mink, fisher, marten, fox, lynx	Nov. 1–Mar. 31.
Otter	Nov. 1–Apr. 30.
Muskrat:[29]	
North of Township 52	Mar. 1–May 14.
South of Township 53	Mar. 1–Apr. 30.
Other fur animals	Unprotected.

Prohibited methods: Unlawful to use poison to take fur animals, to snare wolves, coyotes, or foxes, to spear or shoot beavers or muskrats, or to destroy beaver dams or muskrat houses.

Licenses: Trapping: Resident, $2 (children or wards under 18 of licensee may trap on his land under his license); nonresident domiciled in Canada, $25; alien, $50; resident licensee must return license on or before May 31 to game com-

SASKATCHEWAN—Continued

Licenses—Continued. missioner with statement showing number of each kind of fur animals taken by him. Fur dealer: Resident, $10 (store); traveling dealer $50; traveling agent for resident dealer: Permit $50, $10 for permit north of Township 56; nonresident, $50 (store); traveling agent for nonresident or nonresident traveling dealer, $100; wholesale dealer, $100. Taxidermist: $5; licensee must keep duplicate receipt book and furnish a copy thereof every 3 months to the minister. Tanner: $1; licensee must keep record and make monthly report. Issued by department of agriculture, Regina. Licensed fur trader must make monthly and annual reports of operations. Resident treaty Indians may trap during open season without a license. Consent of owner or occupant required to trap on inclosed or cultivated lands of another.

Possession and sale: Unlawful to buy, sell, or possess unprime pelts of protected fur animals.

Shipment and export: Packages containing fur animals must be plainly marked with full description of contents and names and addresses of consignor and consignee. Export of live fur animals prohibited except under permit of minister; fees for black or silver fox, $25; for cross or red fox or other live fur animals, $5. Unlawful to ship unprime furs or to export any raw furs on which royalty has not been paid. No other restrictions on skins legally taken.

Propagation: Permit required (fee, $5 annually) to operate a fur ranch. Permit to ship live fur animals bred in captivity is required; fee $1 for each animal.

Bounties: Adult timber wolf, $10; pups of prairie or timber wolf, $1; paid only in properly gazetted wolf districts, when half is refunded from provincial treasury.

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[28] *Saskatchewan:* Lieutenant governor in council may alter seasons. Trapping on game preserves prohibited.

[29] Minister may authorize council of any municipality to destroy beavers or muskrats doing damage to highways or other public improvements.

YUKON

Open seasons: [30]	*Dates inclusive*
Beaver, otter (see exception)	Jan. 1–June 30.
Exception: South of Arctic Circle	Jan. 1–May 15.
Marten	No open season.
Lynx, mink	Nov. 15–Apr. 1.
Muskrat (see exception)	Dec. 1–May 31.
Exception: North of Arctic Circle	Jan. 1–June 30.
Fox (see exception)	Nov. 15–Mar. 31.
Exception: South of Arctic Circle	Nov. 1–Jan. 31.
Other fur animals	No close season.

Prohibited methods: Use of poison, pitfalls, spears, or similar devices prohibited, except that commanding officer, Royal Canadian Mounted Police, Dawson, may grant permits to poison wolves and other predatory animals. Traps must be taken up within 15 days after close of open season.

Licenses: Trapping: None required of resident; nonresident, $100. Fur buyer or dealer (purchasing furs for sale or export): Nonresident, $150; resident, $25; mercantile establishment buying furs, $25 (required for each place of business other than head office); issued by gold commissioner or person designated by him.

Possession and sale: Skins legally taken may be possessed and sold at any time.

Shipment and export: Export of raw furs prohibited except under permit issued by direction of the commissioner and upon payment of the export tax. Export of live foxes prohibited. (See "Propagation.")

Propagation: Registration of fox breeders required. Unlawful to export a fox not born in captivity or which has been in captivity for less than a year; any fox born in captivity may be exported under a permit (fee, $5). Fox and other fur ranches, if posted against trespass, may not be approached without owner's consent. No restrictions on other fur animals.

Bounties: None paid.

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[30] *Yukon:* Commissioner in council may alter seasons.

LAWS OF NEWFOUNDLAND

(Laws of 1927 not received)

Open seasons: [31]	*Dates inclusive*
Otter, marten, lynx	Oct. 1–Mar. 31.
Fox	Oct. 15–Mar. 15.
Muskrat	Oct. 1–Apr. 30.
Beaver	No open season.[32]

Prohibited methods: Beaver house or dam must not be damaged by trapper. Use of poisons prohibited.

Bag limits: Twenty-five beavers in such localities as are opened by governor to trapping.

Licenses: Trapping: None required of residents except for beaver (beaver trapping license issued only to resident trappers of three years' standing); nonresident, $501; issued by justice. Fur buyer and shipper, 50 cents; issued by game and inland fisheries board. Fur buyer must report operations semiannually on or before June 30 and December 31 of each year.

Possession and sale: No restrictions on skins legally taken, except beaver.

Shipment and export: (See "Licenses.") Unlawful to export a live fox unless raised in captivity. No restrictions on skins legally taken, except beaver.

Propagation: No restrictions, except as to fox. A fox farm must be licensed; the owner must at stated times make reports to game and inland fisheries board, and premises must be at all times open to inspection by officers of the board. Possession of fox cub or fox taken in close season is prohibited. Unlawful to export a fox not bred on a fox farm, or without permit from board to export a fox bred in captivity.

Bounties: Crow, 20 cents.

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[31] *Newfoundland:* Unlawful to trap on Grand Lake Caribou Preserves.

[32] Governor in council may proclaim open season on beavers in certain localities. Skins of beavers must be forwarded through magistrate to department of marine and fisheries, which has sole power to purchase or export.

LAWS OF MEXICO [33]

Open seasons:	*Dates inclusive*
Bear	Sept. 1–Oct. 31.
Beaver (male only)	Nov. 1–Feb. 28.
Kinkajou	Nov. 1–Dec. 31.
Armadillo	Oct. 1–Dec. 31.
Alligator	Feb. 1–Sept. 30.

No open season: Females and young of beaver.

Licenses: Required for beaver: Resident, $15; nonresident, $30. Issued by Secretaria de Agricultura y Fomento, City of Mexico.

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[33] *Mexico:* For further information concerning trapping and fur laws, communicate with Secretaria de Agricultura y Fomento, City of Mexico.

OFFICIALS FROM WHOM COPIES OF FUR LAWS MAY BE OBTAINED

Federal laws: Secretary of Agriculture, Washington, D. C.
Alabama: Department of Game and Fisheries, Montgomery.
Alaska: Executive Officer, Alaska Game Commission, Juneau; or Secretary of Agriculture, Washington, D. C.
Arizona: State Game Warden, Phoenix.
Arkansas: Secretary Game and Fish Commission, Little Rock.
California: Executive Officer, Fish and Game Commission, Postal Telegraph Building, San Francisco.
Colorado: State Game and Fish Commissioner, Denver.
Connecticut: Superintendent of Fisheries and Game, Hartford.
Delaware: Chief Game and Fish Warden, Dover.
District of Columbia: Superintendent Metropolitan Police, Washington.
Florida: State Game Commissioner, Tallahassee.
Georgia: Game and Fish Commissioner, Atlanta.
Hawaii: Fish and Game Division, Board of Agriculture and Forestry, Honolulu.
Idaho: Fish and Game Warden, Boise.
Illinois: Director Department of Conservation, Springfield.
Indiana: Superintendent of Fisheries and Game, State House, Indianapolis.
Iowa: State Game Warden, Des Moines.
Kansas: State Fish and Game Warden, Pratt.
Kentucky: Executive Agent Game and Fish Commission, Frankfort.
Louisiana: Commissioner of Conservation, Court Building, New Orleans.
Maine: Commissioner of Inland Fisheries and Game, State House, Augusta.
Maryland: State Game Warden, 514 Munsey Building, Baltimore.
Massachusetts: Director Division of Fisheries and Game, State House, Boston.
Michigan: Director Department of Conservation, Lansing.
Minnesota: Game and Fish Commissioner, Department of Conservation, St. Paul.
Mississippi: Secretary of State, Jackson, or Sheriff or County Clerk.
Missouri: Game and Fish Commissioner, Jefferson City.
Montana: State Fish and Game Warden, Helena.
Nebraska: State Game Warden, Lincoln.
Nevada: Secretary State Fish and Game Commission, Box 864, Reno.
New Hampshire: Fish and Game Commissioner, Concord.
New Jersey: Secretary Board of Fish and Game Commissioners, Trenton.
New Mexico: State Game and Fish Warden, Santa Fe.
New York: Secretary Conservation Commission, Albany.
North Carolina: Director Department of Conservation and Development, Raleigh.
North Dakota: Game and Fish Commissioner, Bisbee.
Ohio: Chief, Division of Fish and Game, Department of Agriculture, Columbus.
Oklahoma: State Fish and Game Warden, Oklahoma City.
Oregon: State Game Warden, Portland.
Pennsylvania: Executive Secretary Board of Game Commissioners, Harrisburg.
Rhode Island: Chairman Commissioners of Birds, Providence.
South Carolina: Chief Game Warden, Columbia.
South Dakota: Director Game and Fish Commission, Pierre.
Tennessee: State Game and Fish Warden, Department of Agriculture, Nashville.
Texas: Game, Fish, and Oyster Commissioner, Austin.
Utah: Fish and Game Commissioner, Salt Lake City.
Vermont: Fish and Game Commissioner, Montpelier.
Virginia: Executive Secretary, Department of Game and Inland Fisheries, Richmond.
Washington: Supervisor of Game and Game Fish, 404 Bell Street Terminal (P. O. Box 384), Seattle.
West Virginia: Game and Fish Commission, Charleston; or Chief Game Protector, Buckhannon.
Wisconsin: Conservation Director, Madison.
Wyoming: State Game and Fish Commissioner, Cheyenne.

Alberta: Game Commissioner, Edmonton.
British Columbia: Provincial Game Warden, Victoria.
Manitoba: Chief Game Commissioner, Winnipeg.
New Brunswick: Chief Game and Fire Warden, Fredericton.
Northwest Territories: Director, Northwest Territories and Yukon Branch, Ottawa, Ontario.
Nova Scotia: Minister of Lands and Forests, Halifax.
Ontario: Superintendent of Game and Fisheries, Toronto.
Prince Edward Island: Minister of Agriculture, or Deputy Federal Migratory-Bird Officer, Charlottetown.
Quebec: General Superintendent of Fisheries and Game, Quebec.
Saskatchewan: Game Commissioner, Regina.
Yukon: Gold Commissioner, Dawson.

Newfoundland: Secretary, Game and Inland Fisheries Board, St. Johns.
Mexico: Secretaria de Agricultura y Fomento, City of Mexico.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

October, 1927

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PLANNING AND RECORDING FAMILY EXPENDITURES

IF A FAMILY is to get the most for its income it must make a plan for expenditures. It must then keep a record of what it spends and of what it spends it on, and study this record. In this bulletin, forms for use in making a plan for expenditures are shown, and also forms for recording actual expenditures according to three general methods. The single-page-to-a-class-of-expenditure type, ruled in a loose-leaf book, is suggested as the one which will best fit the needs of most families.

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PLANNING AND RECORDING FAMILY EXPENDITURES

By **Chase G. Woodhouse**, *Home Economist, Bureau of Home Economics*

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RECORDS OF PAST and plans for future expenditures are now regarded as indispensable features of modern business. The United States Government and large corporations all have their records and their budgets or plans for expenditures. By planning ahead they are enabled to avoid, or at least to lessen, the bad effect of business catastrophes, provide for periods of depression, and be ready to take advantage of any chances for favorable buying or investment.

In the same way, a family which plans its expenditures and keeps a record in order to know how well the plan is being carried out and where it might be improved, has some control over its future. Everybody plans ahead, consciously or unconsciously. Why not plan ahead upon a carefully thought-out basis, and then follow the plan?

When the United States Government is planning its budget, every department is represented and has a chance to express its needs. The same system is the one to follow in the family. The ideal arrangement is for the family as a whole to plan its expenditures, each member taking part in the discussion so far as his age and ability will permit. If the family comes together to discuss its expenditures the members have to face the questions, "What do we need? What do we most want? What are our ambitions for the family?" A record of expenditures will show what they actually get. By planning and recording it may be possible to reconcile more nearly needs and wants.

Of course, if not all members of the family are interested, the home maker may have to begin by planning the expenditure of only that part of the income which she controls. However, in most cases the others will wish, very shortly, to join in with her.

CLASSIFICATION OF FAMILY INCOME AND EXPENDITURES

Before one can plan expenditures or keep a record, it is necessary to decide upon a classification of items of income and of expenditure. The following classification has been tried by a number of home makers and found practical. Of course, not every family will have all these items to consider.

INCOME

Income includes all receipts from the following sources: Income from farm or other business or profession (not including what should be put back into the business); salary; earnings from extra or irregular work; interest received on savings account, bonds, notes, mortgages, or other investments; dividends on stocks or other investments; rents received, less the costs of maintaining the properties; profits from the sale of real estate or of other investments which have been made from past family income; gifts of money; profits from boarders and lodgers or from occasional meals paid for by tourists. These last items do not, of course, represent all profit. To find the profit or net income from boarders or lodgers, it is necessary to subtract the cost of keeping them from the amount which they pay.

If a money value is put upon gifts received and upon farm products used in the household and this value entered as income, it is necessary to enter the same items and their money value as expenditures under the proper heading. For example, if the value of a coat received as a gift is entered as income, the item "coat" and its value must be entered also as an expenditure on the clothing record of the person receiving it.

Besides the receipts listed above, a family may have money coming in during the year from other sources. An insurance policy for an endowment may be paid, a policy cashed in, an investment sold, or a loan previously made paid back. These receipts should not be regarded as income. They are past savings which are changing their form. If it is necessary to spend them for current expenses, it means that the property accumulated by the family is reduced by that amount. For method of recording them, see Figures 14 and 15.

Likewise, money borrowed for family expenses is not income but a debt which must later be paid out of income or savings. For method of recording, see the form in Figure 12.

EXPENDITURES

Food:
  Food purchased.
  Meals out.
Housing:
  Rent.
  Taxes on house and lot.
  Fire insurance on house.
  Repairs and improvements on house and on grounds.
  Interest on mortgage on house and lot.
Operating:
  Fuel.
  Light and power.
  Telephone.
  Water.
  Ice.
  Household supplies. These include such things as string, paper, tacks, laundry starch, bluing, soap, cleaning powders, etc.
  Paid service in house and in garden where the latter is not a part of the general farm business.
  Laundry done out.
  Fire insurance on furniture and equipment.
  Rent of safe-deposit box.
  Stationery, postage, telegrams, expressage, freight, and drayage for household.
  Fare on street car, bus, and train in connection with family and household business and to and from work, but not for vacations or pleasure trips.
  Interest on money borrowed for general family expenditures. (Interest on money borrowed for a particular purpose, as for example, education, should be entered under the special heading.)
Furnishings and equipment:
  This includes all furniture, floor coverings, curtains, shades and hangings, bedding, linen, tableware, pictures and ornaments, cut flowers and potted plants for house, all equipment such as musical instruments, washing machines, sewing machines, refrigerators, stoves, brooms, sweepers, mops, and canning equipment, and all utensils and appliances for kitchen and laundry, and replacement and repairs of the same. The cost of storage of household furnishings and equipment should be included here.

Clothing:

This includes a separate record for each member of the family, covering all materials, trimmings, paid labor, ready-made garments, accessories such as hair nets and pins, dry cleaning, pressing, and repairing. Such items as small findings, thread, and cleaning materials, which can not be divided among the individual members of the family, are listed under a general clothing record.

Health:

This includes all expenses for doctor, dentist, oculist, nurse, hospital, medicine, eyeglasses, surgical appliances, special treatments, and travel necessitated by ill health.

Development:

Formal education. Expenses for school, including travel, board, lodging, tuition, special fees, books, and supplies.

Reading matter. Newspaper, magazines, books other than school texts and technical literature.

Public welfare. Contributions to church, social service, educational and civic organizations, and taxes other than those on house and lot and on automobile.

Gifts to individuals outside the family.

Recreation. Movies, theater, concerts, lectures, dues to social clubs, sheet music, phonograph records, radio supplies, athletic supplies, toys, pets, entertaining. If much entertaining is done, this may be made a special heading. In some cases expenses of entertaining should be entered under "Vocation," as explained below.

Vacation and pleasure trips. Transportation, hotels, meals, and any other expenses incurred on the trip.

Vocation. All expenses, outside formal education, incurred in connection with one's business or profession, not charged to the business but paid for out of family income, as attendance at business or professional conferences, dues to business or professional organizations, technical literature, use of auto for promoting business or profession, entertaining directly necessitated by business reasons, and travel and moving expenses in connection with changing positions.

Personal:

Expenditures for toilet articles and supplies, barber, hairdresser, candy, tobacco, jewelry, and other personal items. These would all be covered by a personal allowance.

Automobile:

Cost of gasoline, oil, repairs, replacements, new equipment, fire, theft, and liability insurance, license, tax, and garage if one is rented.

Savings:

Emergency fund. Money kept in the bank to meet unexpected demands. Also, expenditures for insurance carried for the same purpose, such as accident, burglary, and health insurance, including extra premiums on life-insurance policies for partial and total disability.

Savings account.

Insurance, life, endowment, and annuity.

Payments on house.

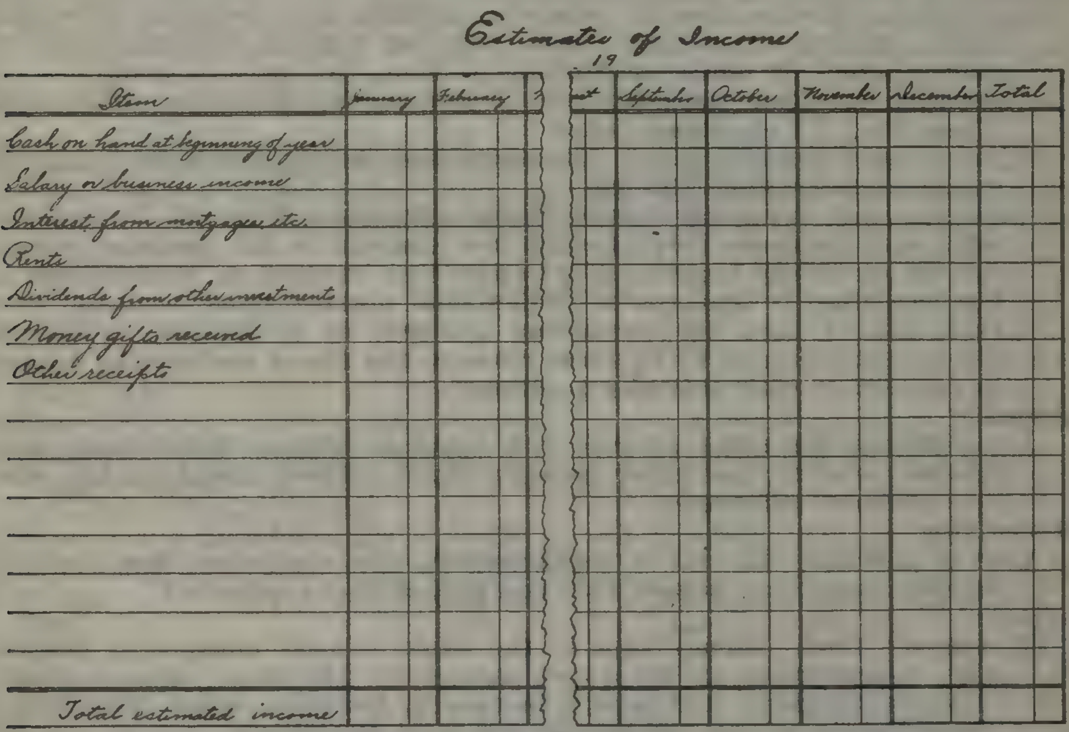
Investments in real estate, mortgages, Government securities, bonds, stocks, etc.

FORMS FOR MAKING A PLAN FOR FAMILY EXPENDITURES AND THEIR USE

There is no standard plan of expenditures for a family of a given size with a given income. It is useful to know what others do and to get information on such points as the cost of an adequate diet for the family, but the detailed plan must be developed by each family to suit its own special needs.

To make a plan for the family expenditures, it is necessary to know what the family expects to receive as income for the next 12 months, and also to know the needs of the family which must be met during that period. The forms in Figures 1 and 2 may be used in making such a plan. It will be found more satisfactory to make a plan for each of the 12 months rather than to plan only for the year as a whole. Of course, it may not be possible to follow the plan exactly, but it can be adjusted from month to month. If the family has any records of last year's income and expenditures, these figures should be listed on the form in Figure 2.

First, on a sheet ruled like the form in Figure 1, fill in for each month and for the year the estimated income from all sources. It is safer to underestimate than to overestimate the amounts. Transfer the totals to the form in Figure 2 on line marked "Total estimated income." This shows the money basis of the plan for expenditures. Next, on a form like that in Figure 2 fill in the more or less fixed expenses for each month. It is usually known fairly definitely what will have to be paid each month for rent or taxes, fire insurance, interest, payments on the house, telephone, and other similar items. Food and many operating expenses, as fuel and light, can be estimated with a fair degree of accuracy. Then decide what can be spent for clothing, development, and savings. Total the expenditures for each month and for the year. Compare these totals with those for estimated income, and if they do not agree revise the plan.



Estimates of Income
19

Item	January	February	st	September	October	November	December	Total
Cash on hand at beginning of year								
Salary or business income								
Interest from mortgages etc.								
Rents								
Dividends from other investment								
Money gifts received								
Other receipts								
Total estimated income								

FIG. 1.—Estimates of income. In making a plan for expenditures, use this form to estimate income which will be received each month from all sources

It is well to remind oneself that savings are a part of the plan for expenditures. If it is found on going over the final plan that the savings are not large enough to provide for the various situations which they ought to cover, and at the same time that other expenditures can not be reduced if the needs of the family are to be adequately met, look at the income side of the estimates, and go over the possibilities of adding in some way to the family income. Might it not be a good plan, for example, to save less now and to spend something in giving one member of the family a special course of training which would enable him to secure a better paying position?

To be safe every family should have an emergency fund, a sum of money in the bank or in some security like Government bonds, which can very readily be converted into cash with little or no loss. Some people like to have an amount equal to one month's income in such form. Others try to have more. Each family can best tell what it needs in its particular situation. Certain forms of insurance, such as accident and health policies, are a type of emergency fund, but, of course, they do not cover all unusual demands.

Besides saving for unexpected happenings, every family will want to save for many specific purposes. It is much easier to save for a definite purpose than just to save, but in saving the long-time point of view is essential. Skimping on the children's education and thus cutting down their future earning power is not justified saving; nor is overwork; nor going without any recreation. As is the case with every item in the plan for expenditures, savings must be considered in relation to all other needs and in relation to income.

In summary, the following suggestions for making a plan for expenditures are listed:

The plan should cover, so far as practicable, all family income and expenditures, including savings.

The plan should be discussed by the whole family, if this is possible.

The plan should be made for at least one year ahead. It is highly desirable to have it divided into estimates for each month.

The plan should treat each class of items separately, but should bring them together into larger groups for purposes of comparison and study of expenditures.

There is no standard plan or budget for a family of a given size and with a given income. Each family must develop its own plan of expenditures on the basis of its particular needs and particular situation. It is useful, however, to know what others are doing and to get information on standards, such as the cost of an adequate diet for example.

In working out the details of the plan, follow this method:

Go over any records which show family income and expenditures on any item in recent years.

Estimate the family income for the coming year. Base the estimate on the amount which can definitely be expected. Better make estimates too small than too large.

Study the needs of the family for the coming year. List these needs in terms of commodities and services under suitable group heads, as food, housing, etc., for each month. It is well to list the fixed and known expenditures first.

Total each group and add the totals for all groups together, and compare with estimated income. It is wise to do this for each month as well as for the whole year.

Study the savings item in relation to all the other items, and on this basis see where it is possible to revise the plan.

METHODS AND FORMS FOR RECORDING FAMILY INCOME AND EXPENDITURES

The method chosen naturally must vary with the needs of the family. One suitable for use by a family living on a large farm would not do for a family living upon a small weekly income in the city. A number of different forms are suggested below.

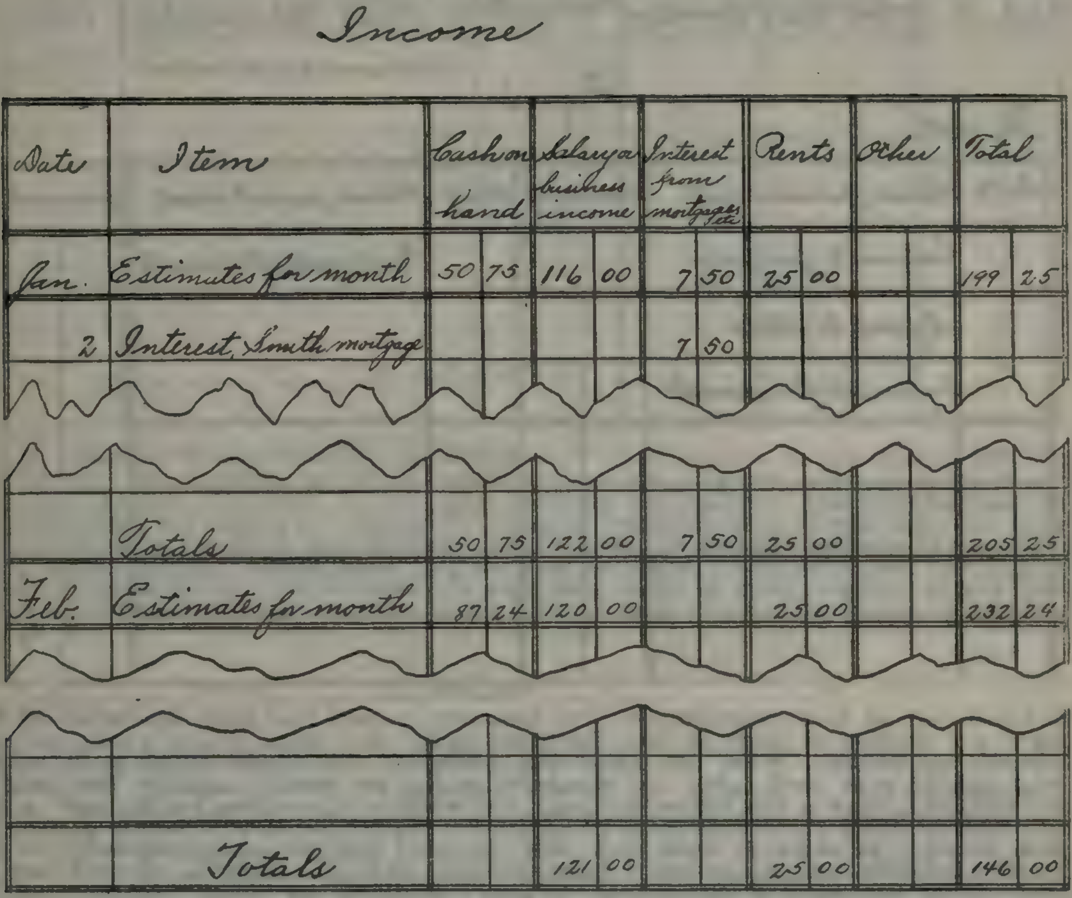
Estimates of Expenditures and Income
19____

Item	January	February		ember	December	Total estimate for this year	Total expenditure for last year
Food purchased							
Meals out							
Total food							
Rent or interest on mortgage							
Taxes on house and lot							
Fire insurance on house							
Repairs and improvements							
Total housing							
Fuel							
Light and power							
Water							
Telephone							
Ice							
Household supplies							
Laundry done out							
Paid service							
Fire insurance on furniture; safe deposit							
Stationery, postage, express, freight							
Car fare, bus, car and train							
Total operating							
Furnishings and equipment							
Clothing—Husband							
Wife							
Child No 1							
Child No. 2							
Child No. 3							
General							
Total clothing							
Health							
Formal education							
Reading matter							
Taxes other than on house							
Church and social and civic organizations							
Gifts to individuals outside family							
Recreation							
Vacation and pleasure trips							
Vocation							
Total development							
Personal—Husband							
Wife							
Children							
General							
Total personal							
Automobile							
Emergency fund							
Savings account							
Insurance, life and endowment							
Payments on house							
Other investments							
Total savings							
Total estimated expenditures							
Total estimated income							

FIG. 2.—Estimates of expenditures and income. Rule across two pages, so as to have a column for each month

There are three general methods for keeping a record of family expenditures: (1) The single-page-to-class-of-expenditure type, (2) the box type, and (3) the double-page-of-columns type. The single-page-to-class-of-expenditure type may be kept in a bound book, in a loose-leaf book, or on cards. In general it is the most satisfactory of the three, since it can readily be adapted to suit the needs of practically any family or individual.

However, where the family is small, perhaps only man and wife and a small child, the box type is often convenient, sometimes as illustrated in Figure 7, sometimes in various combinations with other forms as described on page 12. The double-page or two-double-pages-of-columns type is the least satisfactory.



Income

Date	Item	Cash on hand		Salary or business income		Interest from mortgages etc.		Rents		Other		Total	
Jan.	Estimates for month	50	75	116	00	7	50	25	00			199	25
2	Interest, Smith mortgage					7	50						
	Totals	50	75	122	00	7	50	25	00			205	25
Feb.	Estimates for month	87	24	120	00			25	00			232	24
	Totals			121	00			25	00			146	00

FIG. 3.—Record of income. At the top of the columns in this form, write in the source from which the income is received, using as many columns as the various sources of income make necessary. After "Estimates for month," enter the amount which it is expected will be received from each source, and also the estimated total. These figures will all be transferred from the form in Figure 1. As income is received, write in the date and any description that may seem necessary, and enter the amount received in the column under the proper head. When the account is started, cash on hand should be included in the total for the first month. Do not include it in the total for the following months though it may be entered in a column on this page so that the amount of cash on hand may be known for each month. Total the income received during the month, transfer the total to the summary (a page ruled like the form in fig. 2), draw a line across the page, and write in the estimates and then the entries for next month immediately below it. Use as many pages or cards as are necessary for the year

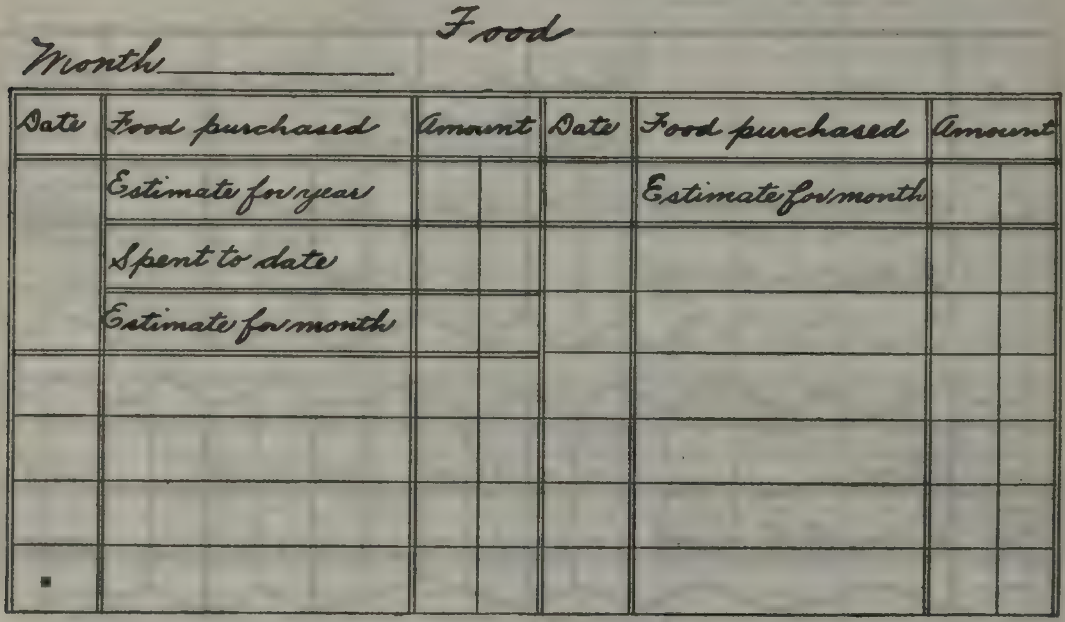
In addition to these three methods for written records, there is the envelope system which social-service agencies have found useful for families where the home maker has difficulty in writing. It is also adapted to teaching children to handle their allowances.

SINGLE-PAGE-FOR-INCOME-AND-FOR-EACH-CLASS-OF-EXPENDITURE TYPE

A record which provides separate pages for each class of expenditure may very easily be made up in a bound book, in a loose-leaf book, or on cards, as one may prefer, following the forms in Figures 3 to 6.

The size of the page may be chosen to fit the handwriting of the record keeper, as suitable books can be obtained in many sizes. Probably the page 8 by 10½ inches would be most convenient. It is always wise to use ruled pages.

If the home maker is interested in keeping the food record in more detail, in order that she may be able to study the nutritive value of the diet as well as its cost, a form similar to the one in Figure 3 might be used, the columns headed milk, cream, cheese; meat, fish, eggs; fruit and vegetables; cereal products; fats and sweets; and miscellaneous, which would cover tea, coffee, flavorings, etc. In this case, quantities of each item would always have to be entered. Meals out would be listed on a separate page ruled like Figure 4.



Food

Month ________

Date	Food purchased	Amount		Date	Food purchased	Amount	
	Estimate for year				Estimate for month		
	Spent to date						
	Estimate for month						

FIG. 4.—Record of food expenditures. The quantity of each food item should be entered for a few months at least, so that the home maker may learn if and where she may improve her buying. When the family has meals out, one column might be so headed or a special page used. Add the expenditures for the month, transfer the total to the summary, draw a line across the page, and write in the entries for the next month immediately below it, as illustrated in Figure 3. Most families will require a page for each month. In order to know how well the plan and the actual expenditures are keeping together, the two entries "Spent to date." and "Estimate for month," may be made at the beginning of each month; or only "Estimate for month" entered and the form in Figure 2 referred to for the other figures. This applies also to the forms in Figures 5 and 6. On the farm any cost of feeding hired men which is included in this food record should be subtracted from the total for the month and only the balance charged to the household, for the cost of feeding hired men is a farm expense and should be entered in the farm accounts

Such a detailed treatment of food expenditures may be necessary where there is a special nutrition problem in the family, or it may be used for a short time in order that the home maker may see clearly how the food that she is giving her family compares with the standards for an adequate diet. But it should be regarded as a special record and not as a necessary part of the record of family expenditures, the two headings suggested in the classification and in Figure 4 being sufficient for all ordinary purposes.

The advantages of the loose-leaf book ruled according to Figures 3 to 6 with a page for each class of expenditure are many. It provides ample room for entering the names and the quantity of all items bought. At any time during the year all the details of the expenditures for each class of items, for food, for housing, for clothing for each individual, etc., are together in such form that one can readily go over them and review what was obtained for the money spent. If the three entries "Estimate for year," "Spent to date,"

Housing

Date	Item	Interest on mortgage		Repairs and improvements		Taxes and fire insurance		Total	
	Estimate for month								

FIG. 5.—Record of expenditures on housing. If the house is owned but is still being paid for, the headings as given would be suitable. If the house is paid for, the column headed "Interest on mortgage" would be omitted. Enter items and total as described for Figure 3. Where the house is rented, a page divided into two sets of columns as in Figure 6, each headed "Rent," would be suitable and would be sufficient for the entire year. Pages ruled like the form in Figure 5 should be used for operating, for development, and for savings. In each case make as many columns as are needed to care for the subheads as given under each of these main heads in the classification, page 2.

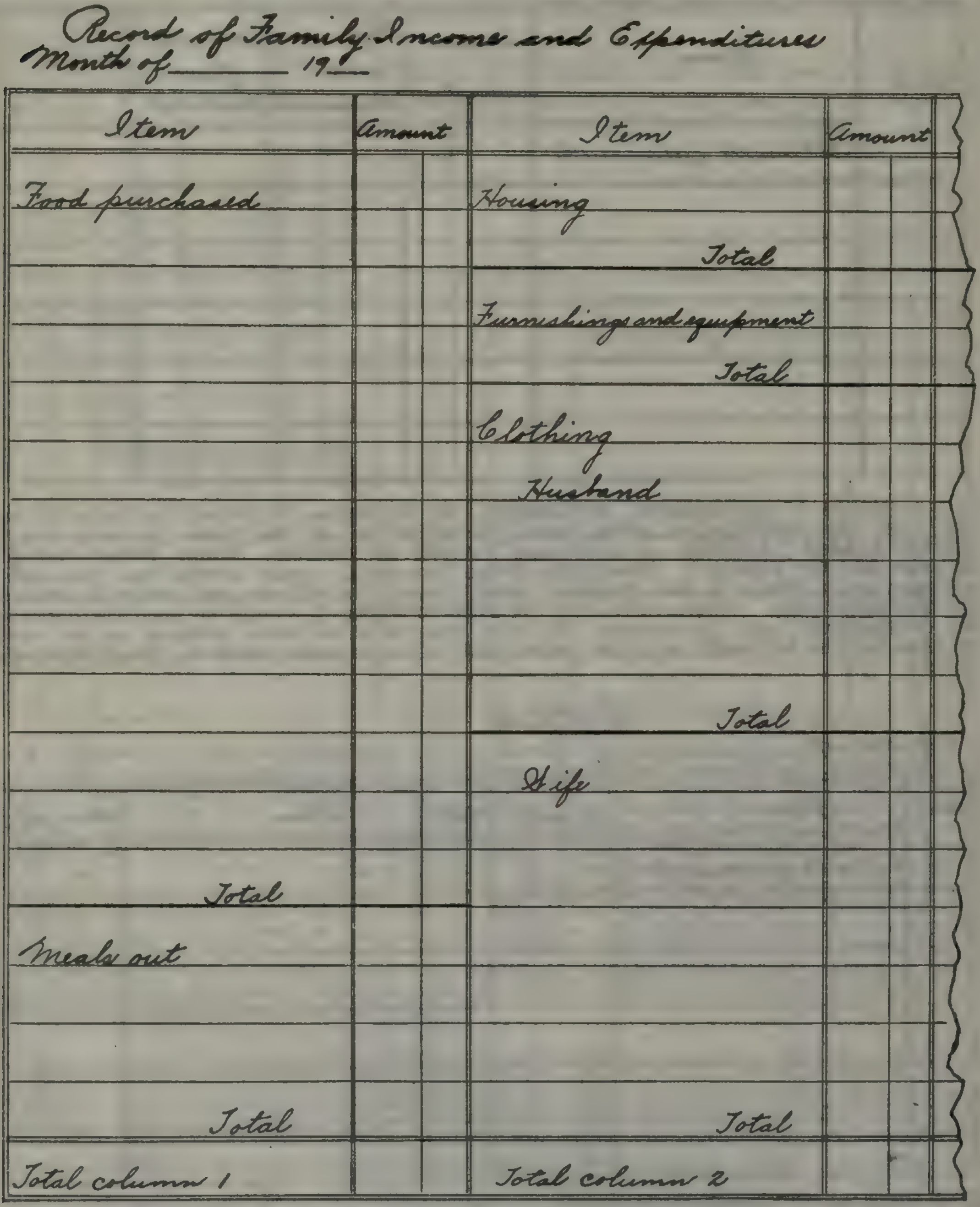
Record of ____________ Clothing

Date	Item	Amount		Date	Item	Amount	
	Estimate for month						

FIG. 6.—Record of clothing expenditures. The name of the individual for whom the expenditures are made should be written after "Record of." If the expenditures are not frequent, one column could be set aside for each individual instead of one page as shown here. For health, personal, household furnishings and equipment, and for automobile, pages ruled like this form would be used, omitting the heading "Record of." In all cases the expenditures would be totaled and the total transferred to the summary as described under Figure 3. Where a farm account is being kept, the total cost of the automobile should be divided between the household and the farm according to the relative amount of use of the automobile for each.

and "Estimate for month" are made the first three entries on the page, it is possible to see without turning to other pages how well the plan and the actual expenditures for each class of expenditure are keeping together.

When the right-hand margin of the pages is cut so that an index of the headings is plainly visible, or if tabs bearing the headings are arranged on the right-hand margin of the pages so that they fall one below the other when the book is closed, there is no trouble in turning to the correct page when making entries.

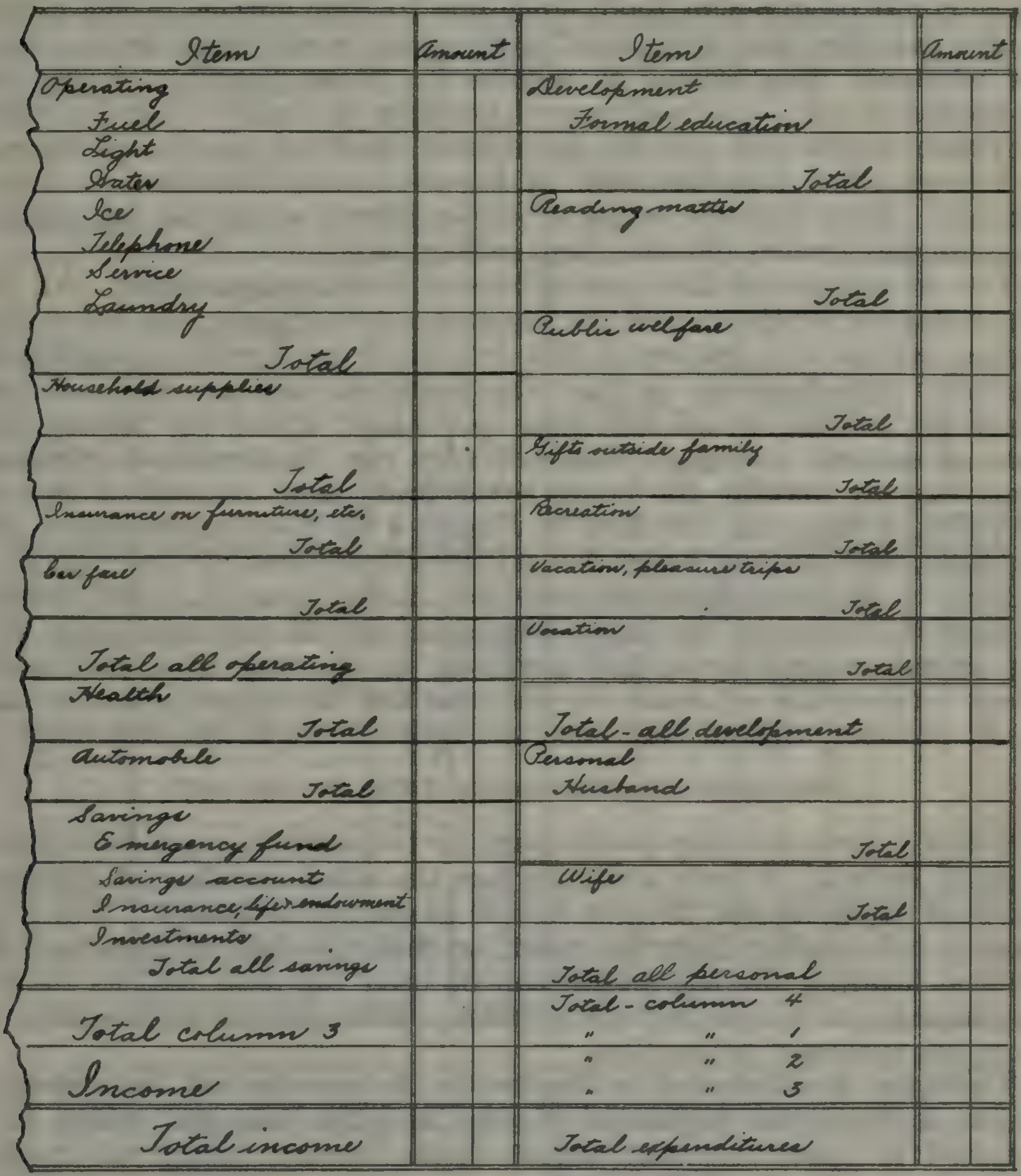


Record of Family Income and Expenditures
Month of ______ 19__

Item	Amount		Item	Amount	
Food purchased			Housing		
			Total		
			Furnishings and equipment		
			Total		
			Clothing		
			Husband		
			Total		
			Wife		
Total					
Meals out					
Total			Total		
Total column 1			Total column 2		

FIG. 7.—Box type of record of family income and expenditures

Where the family feels the need for a very detailed classification of expenditures the forms in Figures 3 to 6 could be adapted to use on cards, those 5 by 8 inches being the most convenient. The headings under which the expenditures are entered are written at the top left-hand corner of the card, and the cards arranged alphabetically under the main headings. For example, food would be a main heading. Behind the card bearing this heading there would be filed two cards, one for food purchased and the other for meals out. Again, operating would be a main heading, and behind the card so headed would be filed cards bearing the various subheads suggested in the classification under operating. If desired, each card could bear only one subhead, in which case it might carry all the entries for the year, the total for each class of items being found each month and transferred to a summary card ruled according to Figure 2.



Item	Amount		Item	Amount	
Operating Fuel			Development Formal education		
Light Water			Total		
Ice Telephone			Reading matter		
Service Laundry			Total		
Total			Public welfare		
Household supplies			Total		
Total			Gifts outside family Total		
Insurance on furniture, etc. Total			Recreation Total		
Car fare Total			Vacation, pleasure trips Total		
Total all operating			Vocation Total		
Health Total			Total - all development		
Automobile Total			Personal Husband		
Savings Emergency fund			Total		
Savings account Insurance, life & endowment			Wife Total		
Investments Total all savings			Total all personal		
Total column 3			Total - column 4 " " 1		
Income			" " 2 " " 3		
Total income			Total expenditures		

FIG. 7.—Continued

It is convenient to use colored cards or cards with colored tabs for the main heads and regard them only as guide cards, all the entries being made on the white cards filed behind these guides. If the cards are kept in a suitable box there should be little difficulty in handling them, but unless a very detailed system is required, or unless a flexible record which can be kept according to different subheads at various times is necessary to meet the needs of the family, some form of book is undoubtedly more convenient for most persons.

BOX TYPE OF RECORD

For small families, especially if living in a city apartment, or for individuals, the expenditures for a month could be kept on two pages ruled off in boxes as in Figure 7. These boxes may be arranged in different ways so that more room may be provided for certain items than is shown here. For example, if a family were boarding, less space could be given to food, since one to four entries in the month would care for that item, and more space would then be available for whatever item seemed to require it. Some headings might not be needed at all. As in all record keeping, the main thing is to find a system which will suit the particular needs of the record keeper.

A page ruled like the form in Figure 3 would be used to record income. Each month's totals of expenditures would be transferred to a summary ruled like the form in Figure 2.

The advantage of this type of record is its compactness. All the expenditures for the month are together on two pages, and the record keeper can see at a glance all the details of the family expenditures. Its chief disadvantage is that the boxes do not provide sufficient space for writing in all the items purchased where the family consists of several persons. This difficulty can, however, be overcome somewhat by making the boxes cover four pages instead of two, or by ruling a page like the form in Figure 4 for food expenditures, for example, and making boxes for all the other items on two pages.

Even in this way, however, with the limited space it is not possible to have the estimates for expenditures entered on the same page with the actual expenditures, and anything in the way of a continuous check between the estimates for the year and the expenditures to date is not possible without reference to Figure 2 and to the summary.

DOUBLE-PAGE-OF-COLUMNS TYPE OF RECORD

A third method is the double-page or two-double-pages-of-columns type of record. Where a family has the usual number of different kinds of expenditures, the two double pages are necessary. The inset page is cut smaller than the outer, so that the date column and the general heading for the month can be used for it as well as for the larger page on which they are written. This smaller inset makes for more convenience in handling.

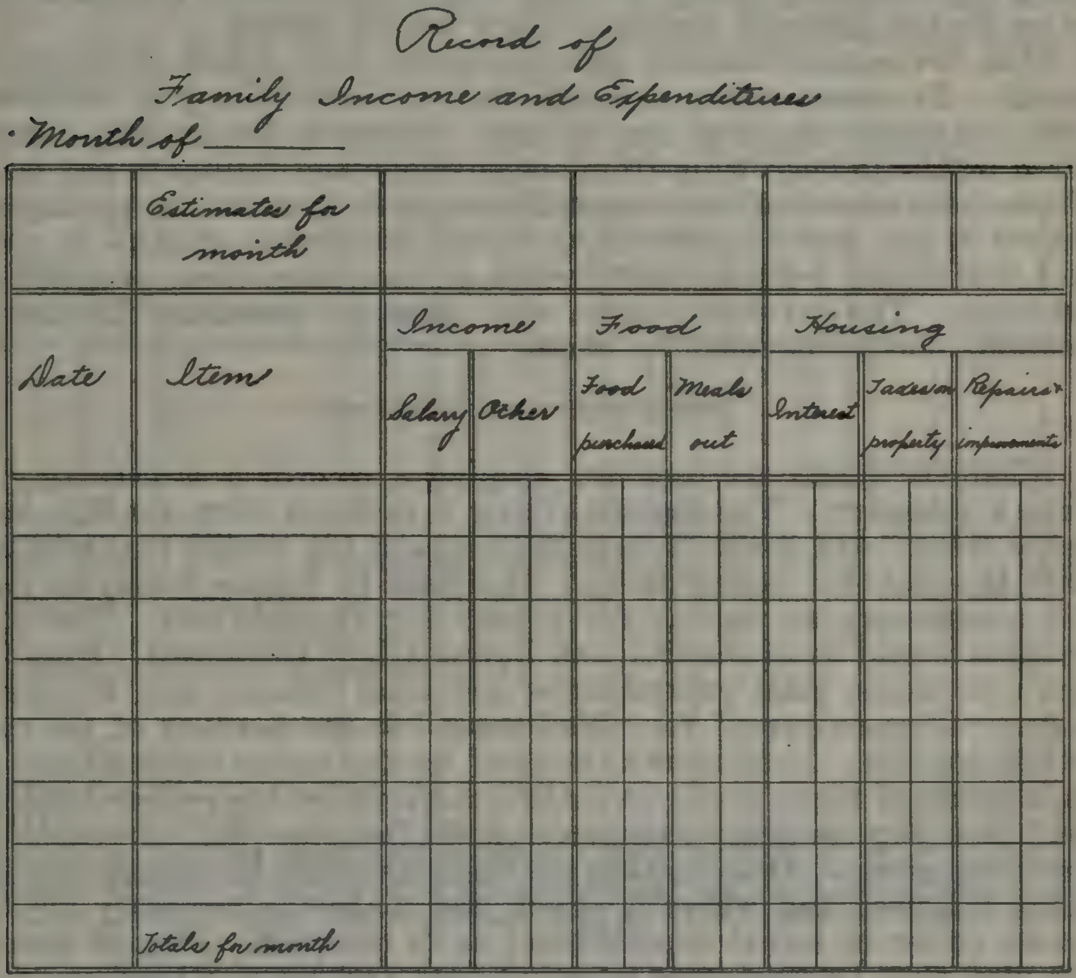
This type is illustrated in Figure 8. Across the top are spaces in which to write the estimated income and the amounts which it is planned to spend on the various items during the given month The columns for the different items are grouped under main heads—for example, under income as many columns as there are sources of income; likewise, under housing as many as there are classes of items it is desired to keep separate.

This double page of columns has the advantage of having on one or two double pages all the expenditures for the month. It has disadvantages in that unless a very large and cumbersome page is used there is not enough room to write in the name and quantity of all the items bought. There is the further difficulty that the column under which the amount is written must in many cases be a long way from the item, so that it is very easy to write the amount in the wrong column and rather difficult to connect the item and the amount.

Also, and most important, while the cost of each class of items is together, the names of the articles bought are scattered down the item column. This makes it difficult to study the items of one particular class of expenditures, as clothing, for example, which have been bought during the year.

ENVELOPE METHOD FOR SOCIAL-SERVICE AGENCIES AND FOR CHILDREN

One very simple method of keeping a check on expenditures is by the use of envelopes. Here the home maker must decide what is to be spent for each class of items, and each week put that amount into the proper envelope and make all payments for that purpose from the given envelope. When using this system a person may, when money is taken out of an envelope, put in a slip of paper with the amount taken out written on it and also, perhaps, the items which were bought. These slips could be gone over once a week or once a month, and the items entered in some more permanent form.



Record of
Family Income and Expenditures
Month of ______

	Estimates for month							
Date	Item	Income		Food		Housing		
		Salary	Other	Food purchased	Meals out	Interest	Taxes on property	Repairs & improvements
	Totals for month							

FIG. 8.—One page of the record of family income and expenditure of the double-page-of-columns type. The columns would be continued across the next page, or would cover two double pages. Under item, on the line after the appropriate date, enter the name and quantity of the article bought and enter the amount paid for it in the column under the proper heading. At the end of each month total each column and transfer these totals to the summary

This is not an adequate record, and does not meet the tests listed on page 19. However, it has been used successfully with children's allowances and with families under the care of social-service agencies, especially where the mother of the family has had little education and writes with difficulty. In such cases the family income is small, is usually received from one or two sources only, and comes in by the week. This system of envelopes is to be recommended only under such circumstances.

One social-service agency has worked out a set of envelopes for use by its foreign and illiterate families. Each envelope is decorated with a gayly colored picture indicating for what the money inside is to be spent. The rent money goes each week into an envelope decorated with a house, the food money goes into one carrying a basket of food, the insurance money into one with a picture of a toy bank, and so on for the different items necessary for the family.

Thus for certain families and individuals this system is sometimes useful. For most others it means keeping more money in the house than is actually required day by day. Necessity for making change often results in borrowing from one envelope and failing to pay back. There is no record of total expenditures up to date and no permanent record of the year's expenditures unless the system of slips is used, and this means a good deal of work in recording them properly at intervals. The envelope system also makes no provision for charge accounts nor for payment by check.

FORM FOR THE SUMMARY

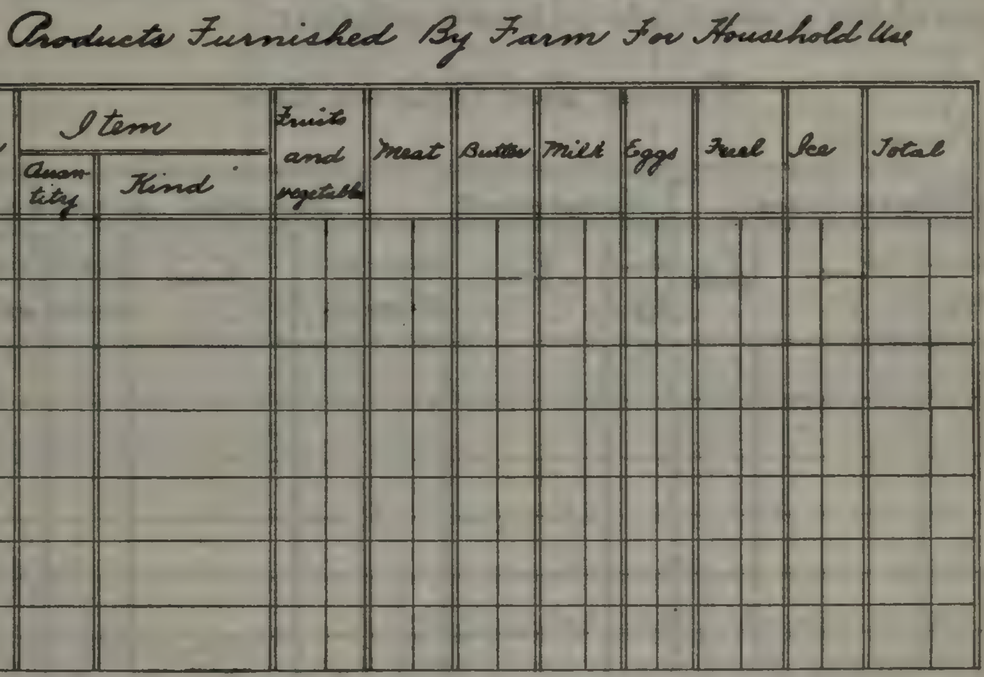
Whatever forms are used for keeping a record, it is necessary to have a summary. The essential thing is to find a form for this summary which will make it easy to compare the actual expenditures with the plan for expenditures. The form in Figure 2 may be used for a summary as well as for a plan for expenditures. The only changes would be in the title and in omitting "Estimated" from the last two items, total expenditures and total income, and in substituting "Expenditures" for "Estimates" in the heading of the next to last column. Each month the total for the actual expenditures on each group of items would be written down under the proper heading, and then the summary compared with the plan for expenditures, group by group. One can then see where the plan for expenditures is being followed and where it is not, and make the necessary adjustments either in actual expenditures or in the plan. For, of course, the plan must be considered as only a plan and not as a hard-and-fast rule which must be followed, and when after studying the records of expenditures it seems best to do so, changes must be made in it.

FORMS FOR SPECIAL RECORDS

Besides the forms for recording expenditures, there are others for various purposes which certain families will find useful. The forms in Figures 9 to 15 have been provided to cover these needs. They should be kept separate from the general record of expenditures.

More of the special forms will probably be used by farm families than by others, since the farm business and the farm household are closely connected. In considering the total value of the living of the farm family, it is necessary to know not only what has been spent in cash but also what the food, fuel, ice, and housing furnished by the farm and used by the household are worth.

The form in Figure 9 is to be used in recording goods furnished by the farm. The best method is to have a card hanging in the kitchen. When fruits and vegetables are brought in to be eaten immediately or to be canned, the kind and quantity should be written on the wall card. In the same way when meat or vegetables are brought out of storage for use, the kind and quantity should be written on the card; likewise the quantity of wood when set aside for family use, and ice as used. Care should be taken not to enter the same product more than once. For example, if whole milk is listed, then do not list again the cream or the butter from that same milk. Each month the items on the wall card should be transferred to a page ruled like the form in Figure 9.



Products Furnished By Farm For Household Use

Date	Item		Fruits and vegetables		Meat		Butter		Milk		Eggs		Fuel		Ice		Total	
	Quantity	Kind																

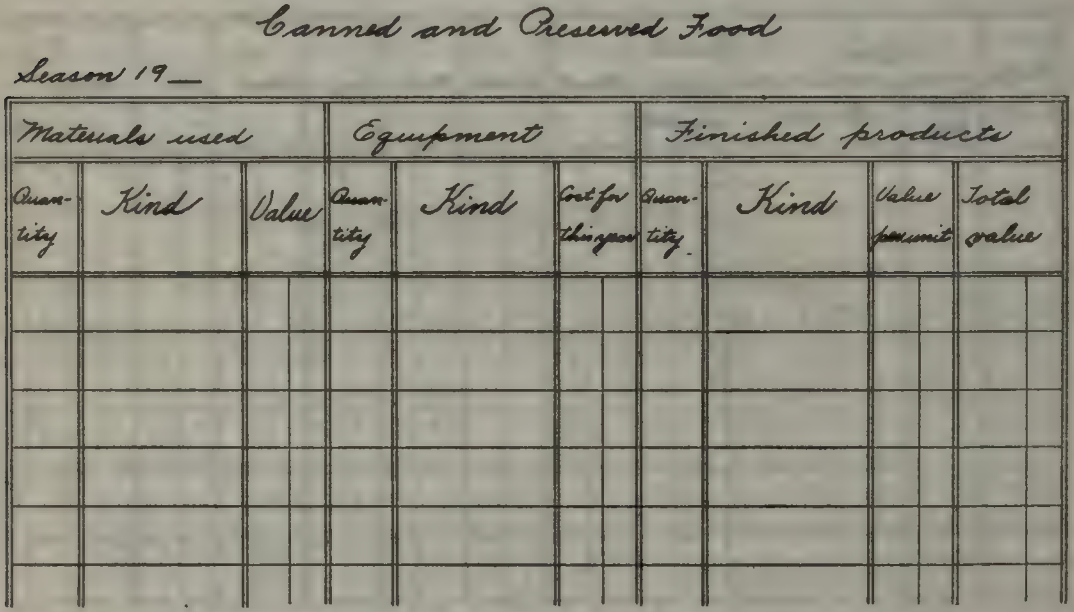
FIG. 9.—Record of goods furnished by the farm for family use. Across the top of the columns write in the names of the different things furnished by the farm, such as fruits, vegetables, meat, milk, and eggs, using as many columns as are needed. Then transfer from the wall card the name of the items and the quantity. Value each item at the price which would have been paid for it if bought at the place where similar supplies are purchased

If the total value of food, fuel, and ice furnished by the farm were entered in the summary under food and operating, then the same total would have to be entered as income. The simplest method is to regard products furnished by the farm as a separate record and not try to combine it with the cash expenditures. At the end of the year it is, of course, necessary to realize that the value of these furnished goods, as well as the rental value of the house, is to be considered as much a part of the farm family income as the actual money which the farm has brought in.

To find the value of canned or preserved food, it is necessary to know both the value of the material which has gone into a particular project and the cost of the equipment used.

When the record is first started, an inventory should also be made on the form in Figure 13 of all canning equipment on hand and the amount paid for it divided over the number of years it will last. Then each year under equipment, on a page like Figure 10, the first entry would be equipment on hand, cost for this year. Add to this the present year's cost of equipment, and divide the total by the number of quarts or other units made during the season. This gives the cost per unit for equipment.

Also on a page ruled like the form in Figure 10, under material used list the kind, quantity, and value of all fruit, sugar, and other materials, and if possible, fuel used in each canning project. To this total add the cost per quart or other unit for equipment multiplied by the number of units made in this particular lot. The total is the value of this kind of preserved or canned food, not taking into consideration the value of the labor required to make it, nor interest on equipment, both of which would have to be included if one were canning or preserving for profit, and ought to be included if the value of the product is to be known definitely.



Canned and Preserved Food

Season 19__

Materials used			Equipment			Finished products			
Quantity	Kind	Value	Quantity	Kind	Cost for this year	Quantity.	Kind	Value per unit	Total value

FIG. 10.—Record of canned and preserved food. Enter equipment, including jars, rubber rings, etc., bought during the season. In the case of those articles which will last more than one year, write in only the cost for this year. Suppose jars last three years on the average and cost 15 cents apiece, the cost for this year would be 5 cents. Such articles should also be listed on a page ruled like the form in Figure 13, household inventory. There, under "Remarks," note amount listed each year on the form in Figure 10 as cost for this year

This special record of the cost of canned and preserved food should be kept quite apart from the general record of family expenditures. If the canning is being done for family use, all canning equipment should be entered under furnishings and equipment, and all fruits and other foods under food, as purchased.

HOW TO KEEP A RECORD OF FAMILY EXPENDITURES

It is a good plan to make one particular member of the family responsible for actually keeping the record. Each member of the family should report to him or her all expenditures made from the general family income, or a notebook may be left in some convenient place and every day each member write down in it his expenditures. Then the record keeper can transfer these to the record once a week or oftener. If a certain time of day or week is set aside for doing this, it becomes a part of the general routine and is kept up to date.

Expenditures made out of personal allowances should not be entered in the family record. These should be regarded as the private affair of the individual making them and recorded in his own book. In the case of children, of course, guidance will be needed.

Garden Record

Date	Expenditures	Amount	Products used			Products sold		
			Quantity	Kind	Value	Quantity	Kind	Value

FIG. 11.—Record of the expenditures on and receipts from the garden or the poultry. Enter all products sold and the amount received, all products used in the house and the value at the price which would have been paid for them if purchased, also all expenses connected with the garden or poultry. All supplies and paid labor would be expenditures. Add the totals of products sold and products used. Subtract the total expenditures from this total, and the balance represents the gain of having a garden or keeping poultry. To find the true profit, one's own labor, interest on land and equipment, and depreciation would have to be considered

Accounts Receivable

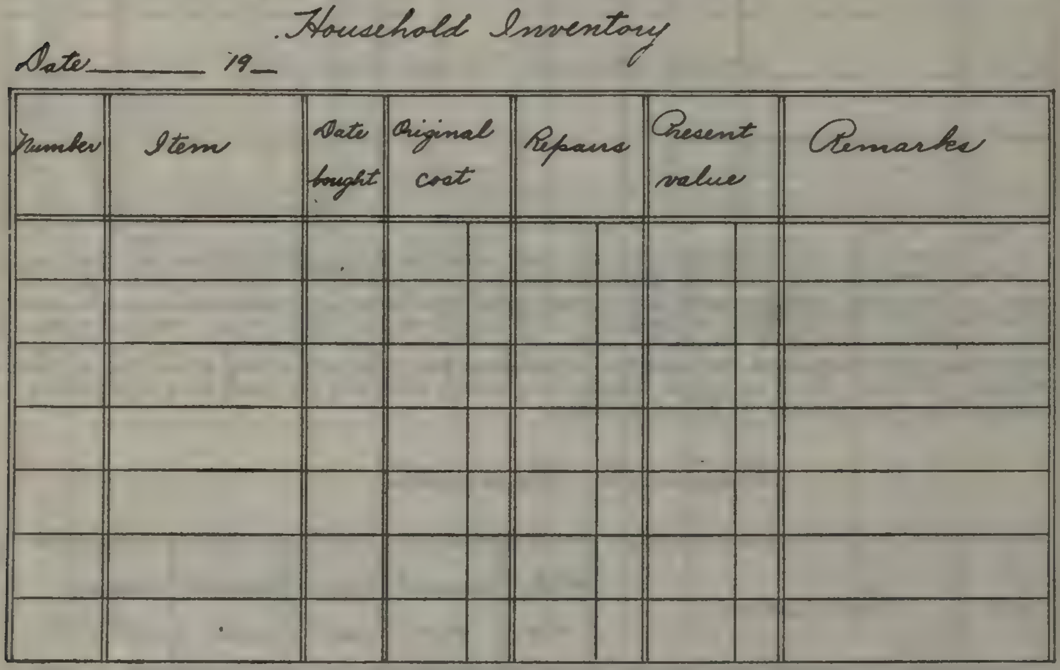
Date	Description	Date due	Amount due	Date rec'd	Amount rec'd	Amount still due

FIG. 12.—Record of accounts receivable and accounts payable. Where the home maker is selling garden produce, for example, and her customers do not all pay cash, a page for accounts receivable will be useful. The same form may be used to record accounts payable where the family runs accounts or has debts which are being paid at intervals, by changing the headings "Date received" and "Amount received" to "Date paid" and "Amount paid"

All items should be entered under the date when the expenditure is made. Where goods are charged they should be entered as expenditures for the month in which they were purchased. The items may be actually written down in the record the day they are bought or when the itemized bill is received. But they all should be entered as of the month when bought regardless of when they are paid for. If only a part of the bill is paid when received, the balance may be noted on a page ruled like the form in Figure 12 and headed "Accounts payable." Expenditures made by check should be entered just as if cash were paid.

In every case the name of the article as well as the amount paid for it should be written down under the proper heading in the record. It is highly desirable that the quantity of each item be entered also.

The summary is, perhaps, the most important part of the record. Each month the totals for each class of expenditures must be transferred to the summary, so that the total actual expenditures and the entire plan for expenditures may be compared and studied.



Household Inventory

Date______ 19__

Number	Item	Date bought	Original cost		Repairs		Present value		Remarks

FIG. 13.—Inventory of household furnishings, equipment, and personal property. This inventory should be made in duplicate and one copy kept in some safe place outside the house, as such an inventory is of value in making insurance adjustments in case of fire. An inventory is also of use in helping one to plan ahead for replacements of furniture and furnishings. It should be kept up to date by entering all new articles once every six months or year

As has been said, expenditures for boarding farm help or on automobile used for farm business should not be included in the expenditures for food and for automobile as transferred to the summary. Further, if such expenditures are made out of income which has been listed on the form in Figure 1 as household income, then either the amount of such expenditures must be paid back to the household out of farm business funds, or the amount must be deducted from the income listed on the form in Figure 1 as household income, since it has been used not for family expenditures but for the farm business.

It will be noticed that no provision has been made for a formal balance. This has been done purposely. In a well-thought-out plan of expenditures, total estimated expenditures, including savings, will equal total estimated income. If this plan is followed and a careful record kept, on the summary, total expenditures plus cash on hand will equal total income. If they are nearly alike, then there is no need to take time trying to make the figures correspond exactly. There are other things in a record of greater value than a set of balanced figures.

TESTS OF A SATISFACTORY METHOD FOR RECORDING FAMILY EXPENDITURES

In deciding upon what method of record keeping to follow, the important thing is to bear in mind its purpose. Records of expenditures are kept not for the sake of the record but in order that the family may get the most satisfaction for its money. Indeed, one of the objects of making a plan for expenditures and keeping a record is to develop and establish desirable habits of expenditure so that a detailed record will become less and less necessary.

Record of Investments

Date made	Description	Amount paid		Remarks

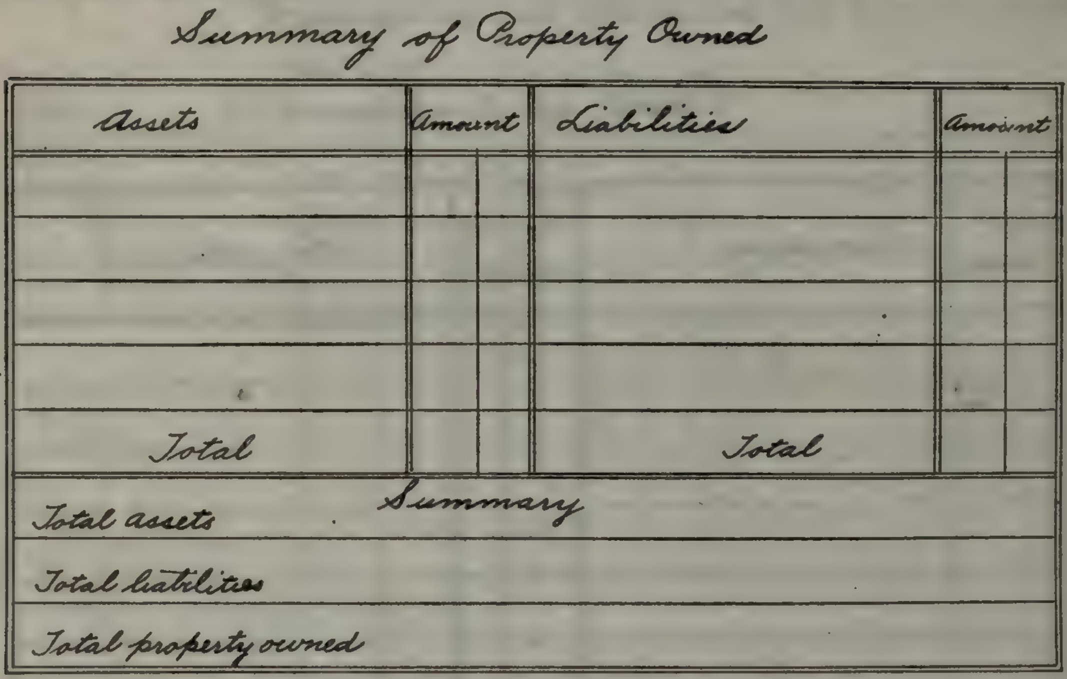
FIG. 14.—Record of investments. Write down the date when the investment was made, a brief description of it, as for example first mortgage on John Smith's farm, the amount of money put into the investment, and under "Remarks" the rate of interest, the dates it is to be paid, and any notes about time and method of paying principal. Also, note when any investment is sold. Until reinvested the amount received could be listed here as "Cash held in bank for investment." This record should be referred to when filling out the form shown in Figure 1, for source and amount of income for the coming year.

As it is the general custom to keep insurance policies and such papers in the safe-deposit box or in the bank, it is wise to have a record of the policies one has for life, fire, and other insurance, and of the dates when the premiums are due and their amount. Such a record may be kept on a page ruled like the above. Under "Remarks" enter the amount of the premium and the dates upon which they are due.

One of the mistakes that has often been made in keeping records of family expenditures has been due to a false idea of simplicity. Too often a person will start keeping a record by writing on one page or in one column all money received and the source, and on the next page or in the next column all the money paid out and the items for which it was paid. At the end of the month these two pages or columns are totaled. This gives merely two money totals—amount received, and amount spent. This type of record may look simple, but in the long run, if any real use is to be made of it, a great deal of work will have to be done in sorting out the items under various heads. What it is necessary to know is not merely the total amount spent but what has been spent on clothes, on food, on recreation, and on other principal items, and what was obtained in return.

The items should be classified when entered in the record. At first glance this may look complicated, but in the end it is much simpler than any other method. Of course it is useful to have a memorandum book in which expenditures may be jotted down as made, but when these are transferred to the regular record they should be entered under the suitable heading.

But a record of expenditures is not something merely to keep. It is something to study and to use as the basis for correcting past mistakes in spending, and for making a better plan for the future. If a record is analyzed, the good and bad points in the management of family finances will come to light and it will be possible to make changes with some assurance that they will result in improvement in the family situation.



Summary of Property Owned

Assets	Amount		Liabilities	Amount	
Total			Total		

Summary
Total assets
Total liabilities
Total property owned

FIG. 15.—Summary of property owned at the end of the year. Under "Assets", write down all cash on hand, money in checking account, and savings account; the present market value of any real estate, stocks, bonds, mortgages, notes receivable, and other investments or business; the present cash value of insurance policies of all kinds; the present value of furnishings and equipment; the present value of the automobile and farm equipment and livestock owned by the family; and also the value of any accounts receivable which it seems likely will be collected, and of any other property. Under "Liabilities" list all current bills due, notes payable, and all other indebtedness or mortgages. The difference between the total liabilities and total assets gives the total value of all property owned by the family

The keeping of any record needs care and accuracy, but it is not necessary to go into the refinements of bookkeeping. As has been said, it is not a set of balanced accounts that the home maker is aiming at but a knowledge of what she is getting for her family and how she might get greater satisfaction from the expenditure of the same amount of money. She might think of the record as a diary of the business actions of the family. Nor need the keeping of the record take a great deal of time. For the average family, 10 minutes a day and 2 hours or so each month for the summary should be sufficient.

There are then certain practical tests which may be applied to any method of recording family expenditures. These may be grouped under three heads:

It must be simple and clear and kept with as little outlay of time and energy as possible.

It must show the facts of expenditures and the general financial condition of the family at any time. At the end of the month there should be provision for some way of getting a summary view of income and expenditures for the year up to date, in such a manner that the amounts actually spent for the various classes of expenditures can be readily compared with the estimates or plan for expenditures.

The record must be detailed enough to make it possible to get a clear picture of what the family spent its money for during the year.

In keeping a record the following rules should be observed:

The classification used in the record should be the same as that used in the estimates for the plan of expenditures.

The date of purchase of the article, at least the month, should be recorded.

There should be some brief identifying description, as the name of the article and quantity, for each item purchased.

So far as possible the expenditures upon the different members of the family should be recorded in such a way that what each member is spending can be found without difficulty.

Expenditures should be entered directly under some group head. Certain classes of items may be grouped and entered together in the same page, space, or column, but there must be as a minimum a page, space, or column for each main group, and also for certain subheads under clothing, operating, and development.

Entries for income and for each class of expenditures should be totaled each month, totals entered in a summary, and compared with the totals in the plan for expenditures.

WHAT DOES A FAMILY GAIN BY KEEPING A RECORD OF FAMILY EXPENDITURES?

A record of expenditures enables a family to judge whether or not it is living up to its plan, and to improve that plan. It may be looked upon as a speedometer which shows a family how far it has gone along the road toward its goal. It makes it possible to plan how to spend not only money but time and energy. From it can be found what articles it is most economical to buy, what articles it is most economical to make, and what articles to do without.

A record also gives assurance. If it is decided that a certain sum may be spent for new equipment during the year and a record of what has been spent to date is available, then when a chance to make a purchase on good terms arises there is no doubt, no question of "Should I or shouldn't I?" The family knows, in other words, what it can afford to buy and when it can buy it. It is sure of what it can and can not spend, and on what to spend it.

A record shows mistakes in buying, indicates whether articles bought at a certain place give better value than those bought at another. Knowing what has been bought, and when and where, the knowledge upon which to base future buying is available.

Another thing a record shows is habits of buying. Looking back over a year, a good picture of what has been bought and why it was bought can be had. One can discover the influence of advertising, of fashion, and of passing fads, whether the mail-order catalogue, the installment plan, and charge accounts are a convenience or a temptation, whether bargains are bargains or unnecessary expenditures. None of these things—advertising, fashion, mail order, installment buying, or charge accounts—are necessarily good or bad. It all lies in the way they are used. And that can be found by going over the year's record of expenditures.

Taking part in planning and recording the family expenditures is a part of the necessary education of the children. It helps teach self-control, a sense of justice, a willingness to share, the ability to carry responsibility, and to take part in confidential discussions. If each member of the family has a clear understanding of what the family income is, what it will buy in terms of goods and satisfactions, and what are the necessary family expenditures which must be provided for before the desires of the individual members can justly be considered, there will be more mutual understanding and cooperation between the different members of the family. If such matters are discussed, the high-school girl, for example, will understand better why she can not have just the clothes she would choose if she could, and so throughout the family.

Planning expenditures will not develop a material outlook in the children. On the contrary, the person who knows how to handle money wisely spends less time in thinking about money and need worry less about how to make ends meet than the person who has no training in and little knowledge of wise spending.

Not only will a family and its individual members benefit in these various ways by keeping a record of family expenditures and developing good habits of spending, but because they have more control over their way of living, because they are living better, the community as a whole is better off. Of course everyone has responsibilities not only to himself and his immediate family but to society at large, and his actions as a consumer, the way in which he spends his money, the type of things which he buys, the amount of money he saves, all affect the manner in which the people of the country as a whole work and live.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1554

POULTRY HOUSES *and* FIXTURES

1862 1889

GROWING CHICKS and laying hens need comfortable houses that are dry and roomy, with plenty of fresh air and sunlight. It never pays to overcrowd them.

Detailed information on how to build poultry houses is given in the following pages, so that anyone handy with tools can build them.

PERSONS INTENDING TO BUILD ARE ADVISED TO CONSULT THE POULTRY DEPARTMENT OF THEIR STATE AGRICULTURAL COLLEGE OR STATE EXPERIMENT STATION.

This bulletin is a revision of and supersedes Farmers' Bulletin No. 1413.

Washington, D. C.   March, 1928

POULTRY HOUSES AND FIXTURES

By M. A. Jull, *Poultry Husbandman*, and A. R. Lee, *Associate Poultry Husbandman, Animal Husbandry Division, Bureau of Animal Industry*

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CERTAIN GENERAL PRINCIPLES apply to all poultry-house construction, though local conditions determine to a large extent the exact type which will give best results. Climatic and other conditions vary to such an extent in different parts of the United States that it is impossible to give in this brief treatise a description of the type of house best suited for each locality. This bulletin, therefore, is confined to a discussion of the principles of poultry-house construction. It includes also a plan of a brooder house and one of a laying house.

This type of brooder house, with perhaps slight modifications, should give satisfaction in most parts of the country. The plan of a laying house is suitable for many sections of the country and it serves also to illustrate several principles of house construction.

Plans of houses suitable for conditions in most of the States may be obtained from the State experiment station or State agricultural college.

ESSENTIALS IN HOUSING POULTRY

The first essential in housing chicks or laying hens is comfort, for unless chicks are comfortable they will not grow well and pullets and hens will not lay well. To be comfortable a house must provide plenty of room, be well supplied with fresh air and sunlight, and always be dry.

The second essential is economy. A new house need not be expensive, but it should be durable; the more durable the house the less the cost of housing per year in a period of years. Avoid building cheap, flimsy houses, because they soon have to be replaced.

The third essential is convenience. The house should be conveniently located and should be of such shape and size that work in it can be done with ease. Too often the mistake of building small houses with low roofs is made, so that it is drudgery to care for the chicks or the layers. Since labor is an important factor in the management of poultry, the arrangement of the house for convenience adds greatly to the chances of success.

LOCATION AND SITE

The location should provide good drainage of water and circulation of air, so that the floor and yards will be dry. The house should not be in a low pocket or hollow in which cold air settles. Wherever possible a southern or southeastern exposure should be selected, although this is not so vital if there is good reason for facing the house in some other direction.

Poultry can be raised successfully on any well-drained soil. A light loam which will grow good grass is well adapted for this purpose, whereas a very light, sandy soil through which water leaches freely is best for intensive poultry keeping. A heavy clay or other water-retentive soil is not well adapted to poultry raising, as such land does not drain readily, which makes it much more difficult to keep the stock healthy. Where the soil is of such character the site of the house should be underdrained, and particular care should be taken to see that the house is situated so that all surface water is drained away from it.

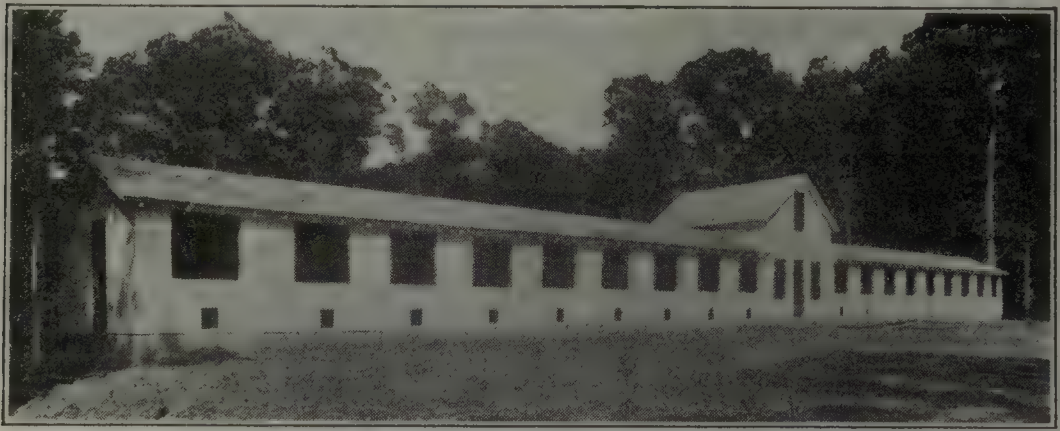


FIG. 1.—An open-front type of house on a good site, well-drained land with trees at the north, providing a windbreak

Houses that are protected by trees or other windbreaks (fig. 1) usually give better results than houses which are exposed.

BROODER HOUSES

The houses in which chicks are brooded and reared should be so constructed as to promote the most efficient growth in the chicks. A brooder house should provide ample protection from the weather but should also be well ventilated, because chicks do not do well if brooded in houses where the atmosphere is stuffy. At the same time no direct draft should pass through the house.

The brooder house should provide plenty of room for the chicks, allowing at least 100 square feet of floor space for 300 chicks. For farm flocks, in most cases, the house should be easily portable. Portable houses for colony stove brooders may be built in different sizes and styles, but they should be of sufficient size and height to be convenient to work in while tending the brooder or feeding the chicks. The shed-roof brooder house illustrated in Figure 2 is used with satisfactory results at the United States Animal Husbandry Experiment Farm, Beltsville, Md.

Detailed plans of a portable shed-roof stove brooder house are given in Figures 3 and 4. This house is 10 by 14 feet and will accommodate from 300 to 500 chicks, but best results are obtained when not more than 350 chicks are kept in one flock.

METHOD OF HEATING

Brooders are heated either by overhead or bottom heat or by a combination of the two methods. Too much bottom heat does not give good results, but either the overhead or the combination method is used successfully. The individual brooder stoves all furnish overhead heat, but allow the chickens to move about, which makes them one of the most satisfactory types of brooding systems.

Many pipe systems have a hover or cover over a section of the pipes in each pen. while others are used without them, and each appears to give good results with different operators. A piece of wool felt or cotton flannel is often used for this purpose.

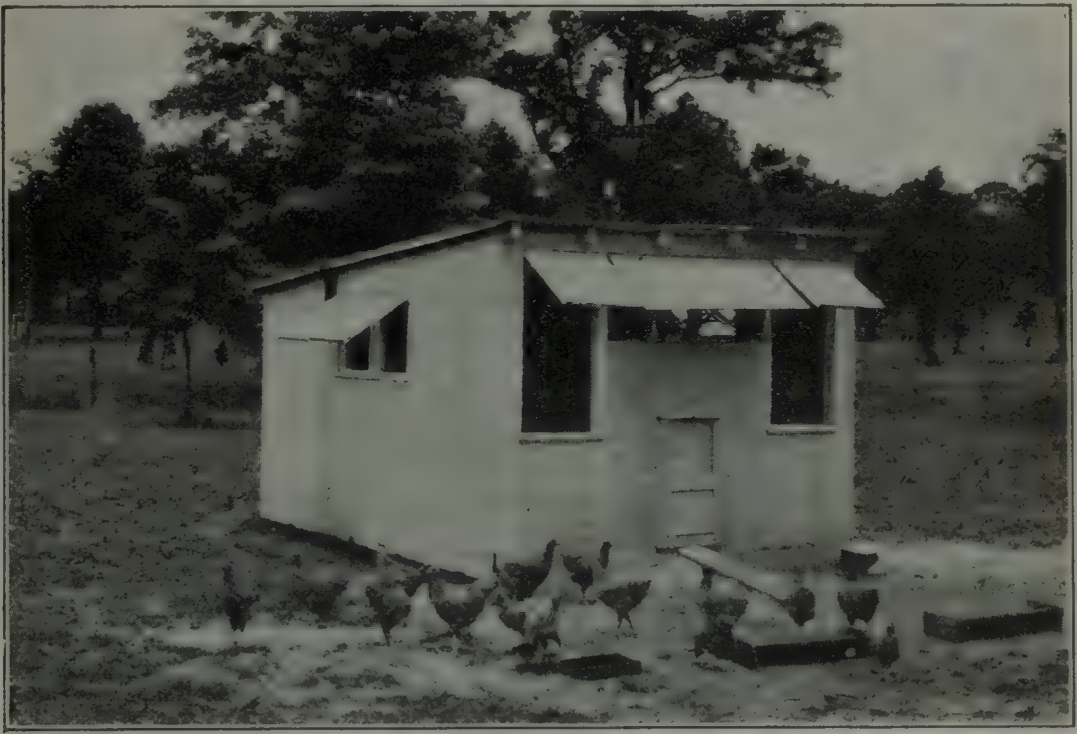


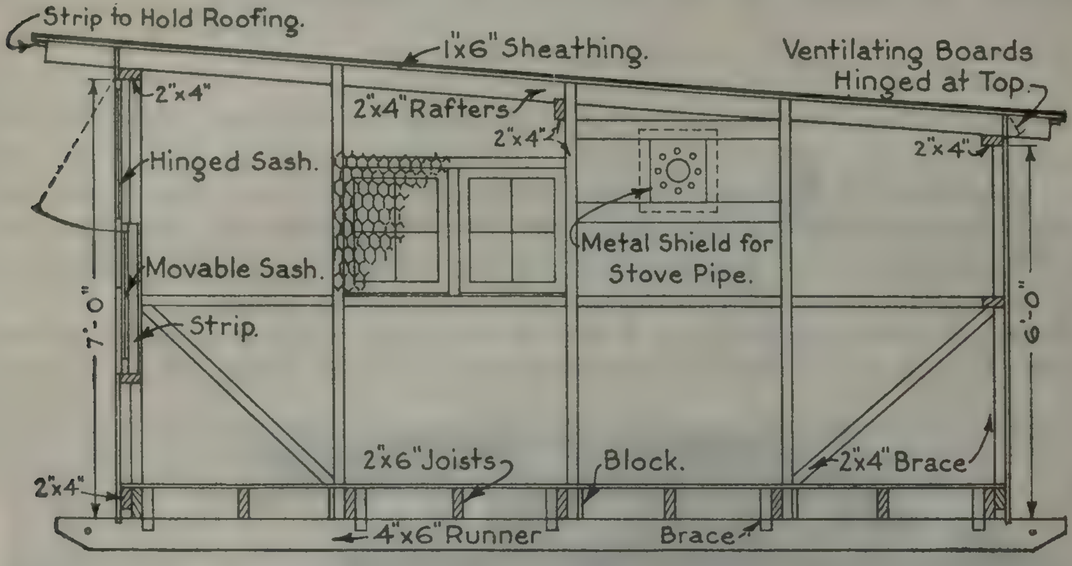
FIG. 2.—A shed-roof type of brooder house with a capacity of about 350 chicks. Used at the United States Animal Husbandry Experiment Farm, Beltsville, Md.

Gas and electricity are also used for heating brooders and hovers with success, and, when available, supply one of the steadiest and most convenient sources of heat.

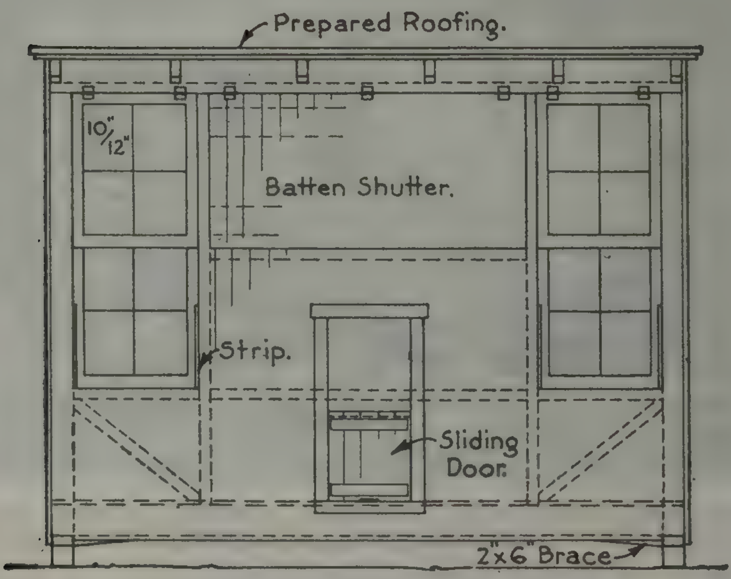
Heaters for the mammoth brooders or hot-water-pipe systems are usually equipped with automatic regulators, which are operated by either expansion of water or electric contact. Both types of regulators have given satisfaction. A reliable regulator is essential to success with any of these systems.

FIRELESS BROODERS

Fireless brooders are used with success by some persons, but require much more attention than heated brooders and are advisable only for emergency use. As their construction is very simple, many persons prefer to build rather than buy them. In this system of brooding, the body heat of the chickens is the source of warmth, requiring that a sufficient number of chickens, depending upon the size of the brooder, be placed in the brooder to generate and retain the heat. Small, fireless hovers with adjustable covers composed of strips of cloth or feathers are used in both indoor and outdoor brooders and in colony houses. A bottle or jug of hot water is sometimes used with these brooders, hot water being put in every night or as often as is necessary to keep the chicks warm and comfortable. A box from 18 to 24 inches square and from 8 to 10 inches deep makes a good hover of this type. The position of the cover used over the chickens in this box is regulated according to the weather



SECTION

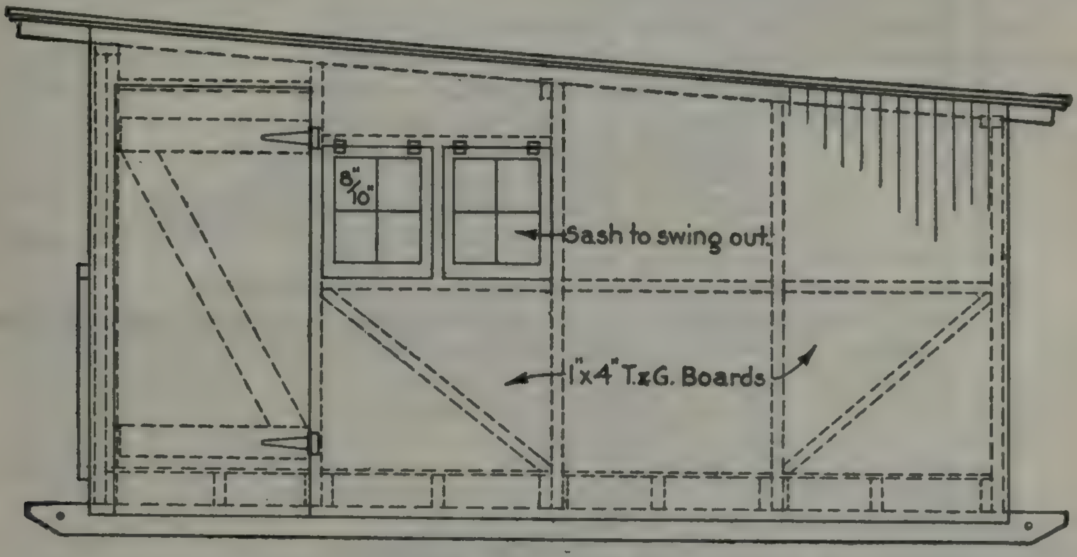


FRONT ELEVATION

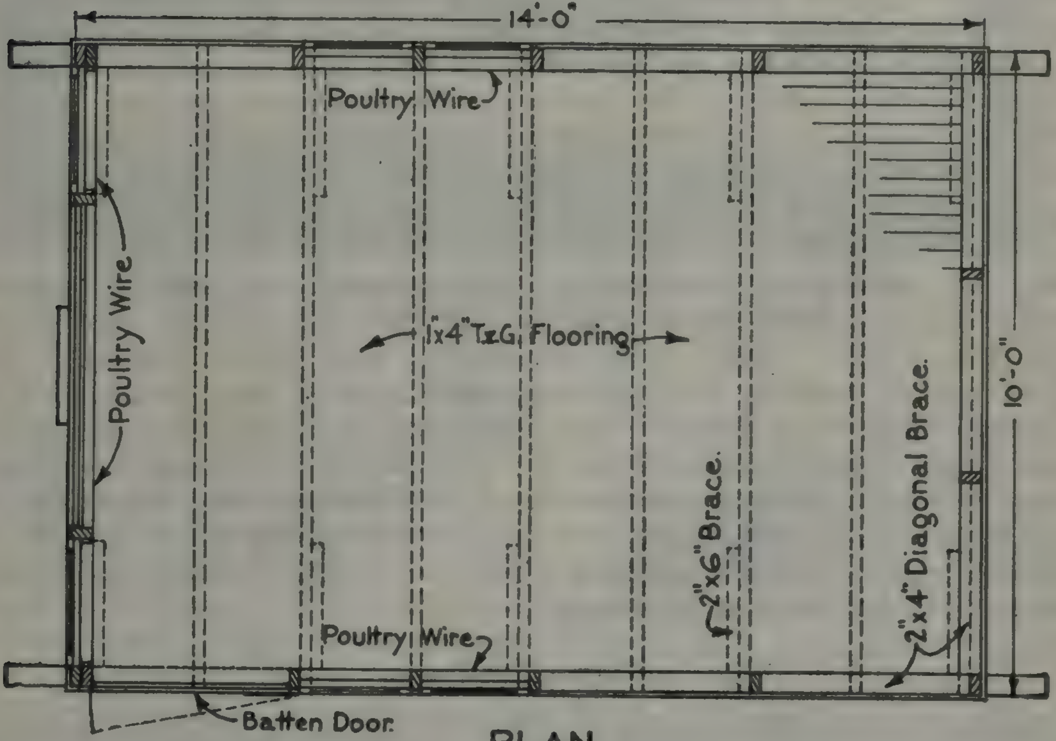
FIG. 3.—Section and front elevation of shed-roof stove brooder house, capacity about 350 chicks, used at the United States Animal Husbandry Experiment Farm, Beltsville, Md.

and the number of the chickens in the brooder. In very cold weather the cover should sag so as to rest on the backs of the newly hatched chickens, and there should be little or no empty space in the hover, while in warmer weather or with older chickens the cover is raised.

From 12 to 40 chicks are usually placed in a fireless brooder, 25 being the average number. The litter in these brooders must be changed frequently, and the chickens must be watched carefully and closely to see that they are comfortable and do not sweat. Fireless brooders may be used in connection with heated brooders, using the latter for 7 to 10 days and reducing the heat, which should be gov-



SIDE ELEVATION



PLAN

FIG. 4.—Side elevation and plan of colony brooder house, which is built on runners, so that it can be easily moved. (See fig. 2)

erned by the season of the year and outdoor temperatures, before transferring the chickens to the fireless brooder. When first placed in the fireless brooder the chickens may have to be put under the hovers frequently, until they learn where to get warm. Fair results are also obtained with these brooders when used in a heated room.

Bill of materials used in the construction of this house is as follows:

2 pieces 4 by 6 inches by 16 feet long, for runners.
1 piece 2 by 4 inches by 12 feet long, for studs.
5 pieces 2 by 4 inches by 14 feet long, for studs.
2 pieces 2 by 4 inches by 16 feet long, for studs.
2 pieces 2 by 4 inches by 10 feet long, for braces.
3 pieces 2 by 4 inches by 10 feet long, for horizontals.
2 pieces 2 by 4 inches by 14 feet long, for horizontals.
3 pieces 2 by 4 inches by 10 feet long, for roof plates.
11 pieces 2 by 6 inches by 10 feet long, for joists and braces.
2 pieces 2 by 4 inches by 10 feet long, for under studs, front and rear.
6 pieces 2 by 4 inches by 16 feet long, for rafters.
220 feet, board measure, 1 by 6 inches, for roof and fascia.
600 feet, board measure, 1 by 4 inches, tongue and groove flooring and siding (including 25 per cent waste).
4 single sash, 4 lights, 8 by 10 inch glass.
4 single sash, 4 lights, 10 by 12 inch glass.
11 pairs 2-inch galvanized hinges.
1 pair 6-inch galvanized T hinges.
70 square feet 2-inch mesh galvanized poultry wire.
Metal shield for stovepipe.
Roof covering for area 180 square feet.
Nails and paint as required.

Long brooder houses adapted for the use of small, coal-burning brooder stoves can be made on the same general principles as the colony house, except to double size, making them 20 feet wide by 14 feet deep, with a partition in the middle. One section can be used for brooding and the other for feeding. Long brooder houses are also used for hot-water-pipe brooders, which are especially desirable for winter brooding. A concrete floor should be installed, because it is more sanitary and durable than any other kind. It is also a good plan to extend the concrete flooring in front of the house about 10 feet. By putting a wire-netting fence around the outside concrete yard, one may keep the chicks off the ground for the first weeks and thus reduce losses from coccidiosis and other diseases. The advantage of having the concrete yard is that the chicks may be allowed outdoors to benefit from exposure to direct sunshine rather than being kept in the house for the first two weeks or longer. Direct sunlight tends to prevent the chicks from getting leg weakness.

Plans of long, stationary brooder houses adapted for the use of hot-water-pipe brooder system may be obtained from the manufacturers of the brooder systems.

LAYING HOUSES

The size of the flock determines the dimensions of the laying house. For instance, a back-yard flock is usually limited in numbers, and since the floor space required is not very great the house is normally not more than 12 feet deep, whereas with a large commercial flock the house should probably be about 20 feet deep. On the other hand, in some sections of the country, land is cheap enough and climatic and other conditions favorable so that large flocks are housed in colony houses, each colony house accommodating from 25 to about 100 birds. In the case of most farm and commercial flocks, however, stationary houses are preferable because of the lower cost of construction, and less labor is required in caring for the birds. In many such cases, however, colony houses are provided for the breeders, while the layers are kept in the stationary houses. The advantages of this system are that the layers may be fed and managed so as to get the maximum fall and winter egg production, while the breeders are given a rest in the fall and then are provided with whatever range is possible before and during the breeding season in order that hatching eggs of the highest quality may be obtained. Stationary houses (figs. 5, 6, and 7) are built either as single units or as long, continuous houses divided into sections. Other desirable houses suitable for different sections of the country are seen in Figures 12 to 15, inclusive.

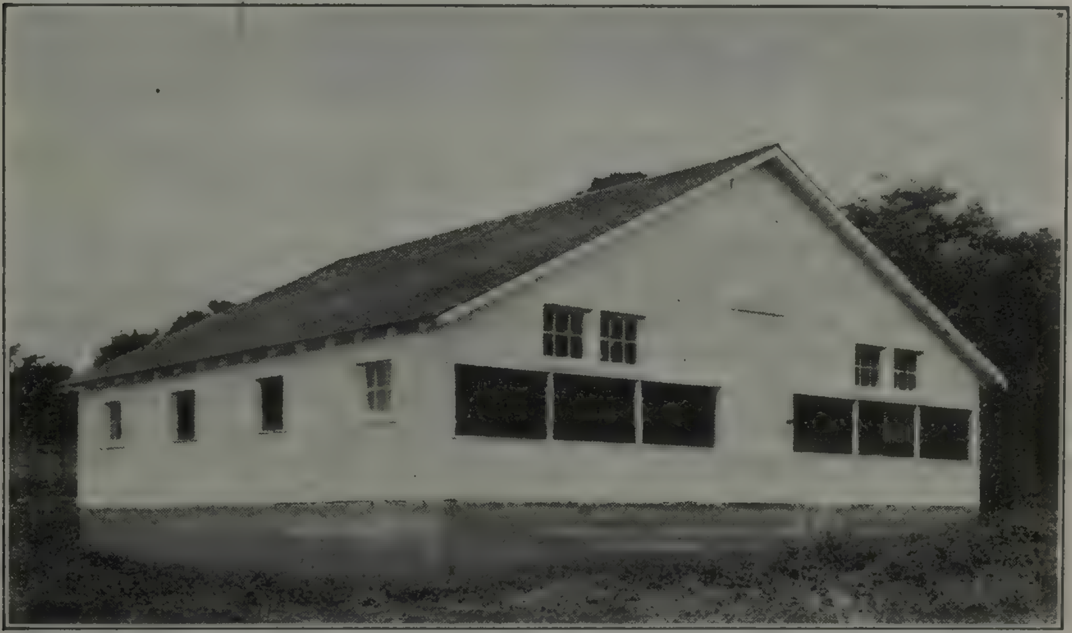


FIG. 5.—A very satisfactory type of house for farm use. The Missouri straw-loft house, 30 feet square, will accommodate from 225 to 300 birds, depending on their size. The same type of house can be built 20 feet square to accommodate 100 hens

CAPACITY OF HOUSES

A house so built that the attendant can stand up and work conveniently will have cubic air space enough if from 3 to 5 square feet of floor space per fowl is allowed. The extent of floor space necessary depends on the housing system employed, size of flocks, weather conditions, and size of the birds. Where the climate is mild and the hens have free range most of the year more birds can be kept on a small floor area under the colony system than under the intensive system. Three square feet of floor space per bird should be allowed with good-sized flocks of Leghorns and 4 square feet with general-purpose breeds, increasing to 3½ square feet for Leghorns and 4½ square feet for general-purpose breeds when flocks are small. On the other hand, in a mild climate, a space of 3 square feet is enough for Leghorns and 3½ square feet for the general-purpose breeds when kept in colony houses with free range.

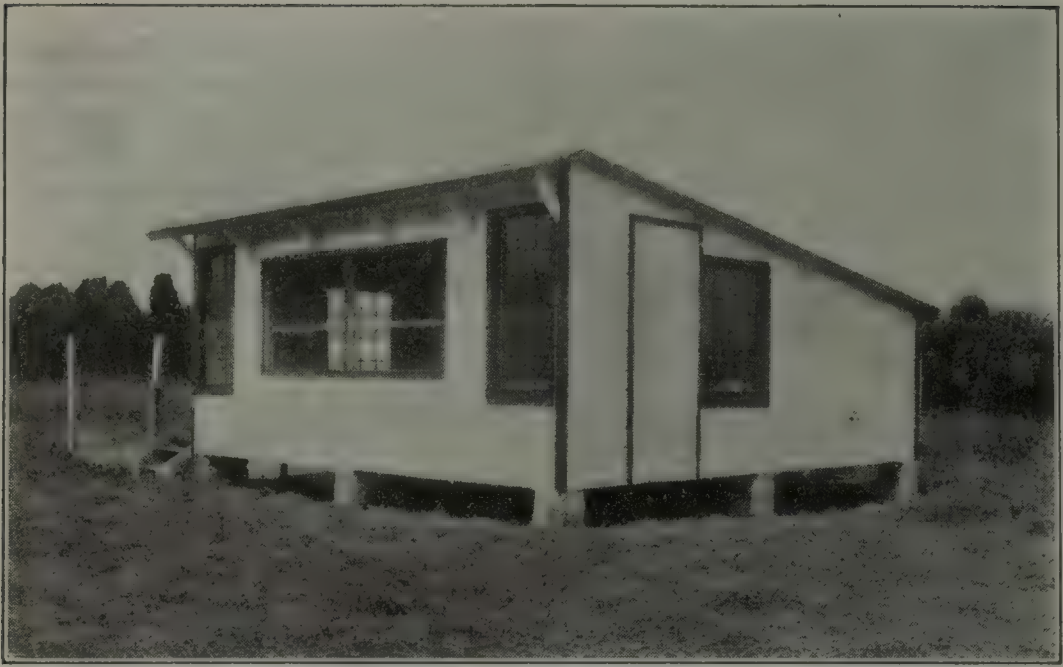


FIG. 6.—The New Jersey unit house, 20 feet square, is very satisfactory in many sections. Glass windows and cotton curtains are used in front, though in New Jersey they are needed but very little. This house is very well lighted

Colony houses accommodating from 30 to 50 hens are about as large as can be moved easily, but larger numbers may be kept in one flock in a long house. Flocks of from 100 to 500 are well adapted to average conditions for the production of market eggs. Large flocks require less labor, fewer fences, and a lower house cost than small flocks, but there is a greater risk of disease and the individual hen receives less attention.

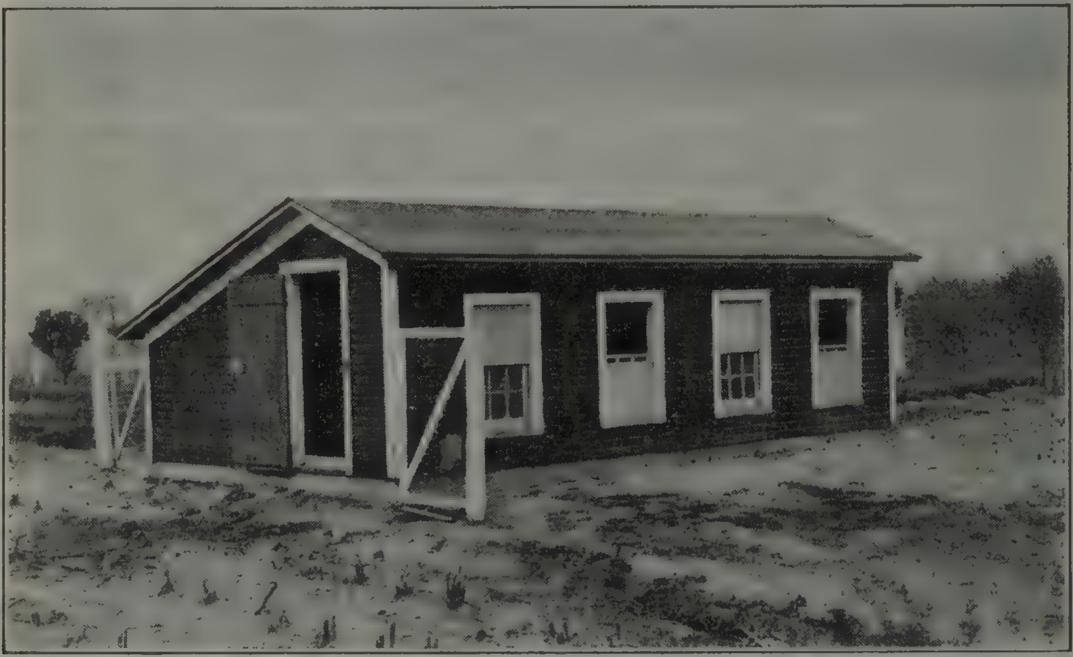


FIG. 7.—A Michigan-type house in which cotton curtains and glass are used in sliding sash

YARDS AND FENCES

Laying fowls should be confined to good-sized yards adjacent to the laying house rather than allowed to roam over the premises, because the layers can be managed more efficiently and they should not be allowed with the cattle and hogs. The value of fresh, sweet land for poultry can hardly be overestimated, and the yards should be large enough so that they can be cultivated and sown to a grass or other green crop.

A good grass sward can be maintained on fertile soil by allowing from 220 to 260 square feet of land per bird (200 to 167 birds to the acre). More space per bird is necessary on poor grassland. A much larger number of fowls is usually kept to the acre on sandy soil, where double yards are used and the land is frequently cultivated. Under this system as many as 1,000 laying hens are sometimes kept on 1 acre, for egg production only, when the stock is not used for breeding and no chicks are raised. A desirable arrangement of yarding, especially where green feed can be grown throughout the year, is to have three yards of equal size for each house, one in front and two in the rear, the rear yards extending beyond the house. The single yard in front makes fewer gates to open and close in going to and from the house. The birds may be alternated from yard to yard and a green crop grown in each yard as soon as it is vacant.

The general-purpose and meat breeds require fences from 5 to 6 feet high, while for Leghorns a fence from 6 to 7 feet high is necessary. To keep Leghorns in, it may help to slant the upper 2 feet of the fence in at an angle of about 30°. A strand or two of barbed wire strung on top of the woven wire is good. It is sometimes necessary to clip the flight feathers of one wing of any bird which persists in getting out. A board or wooden strip along the top of the fence is not advisable, as hens will often fly over.

Posts may be set or driven. They should be from 8 to 10 feet apart for common hexagonal poultry netting or 16 to 20 feet for woven wire. Woven-wire fencing makes a better-looking fence and will last much longer than the common poultry netting. Corner posts should be about 8 inches in diameter, set 4 feet in the ground, and they may be set in concrete or braced, or both. Line posts may be 4 or 5 inches in diameter, set 3 feet in the ground. Creosoting the ends that will be below ground or treating them with some other preservative will make the posts last longer.

DETAILS OF DESIGN

ROOF

The roof should be well constructed and made water-tight. Shingle roofs should have a one-third pitch, while composition or metal roofs may have a smaller pitch or be almost flat. However, the roofs with considerable pitch will last longer than roofs which are nearly flat. Different types of roofs are illustrated in Figure 8.

The shed or single-slope roof (fig. 8, A) is practical for houses up to 20 or more feet in width if a girder and posts support it. A girder is needed only in shed-roof houses wider than 14 feet, except in sections where there is considerable snow, in which case the space should be reduced to 12 feet. Twenty feet is as wide as is usually used for a house for laying hens, although even wider houses are used successfully. The shed-roof type is practical and easy to build and allows a high front to the house.

The combination or two-pitch roof (fig. 8, B) and the semimonitor roof (fig. 8, E) are adapted for buildings from 16 to 24 feet wide, while either of these styles or the monitor (fig. 8, D) and the gable (fig. 8, C) roofs may be used for wider buildings. The combination roof on a house more than 16 feet wide gives good headroom at a moderate cost, reduces the surplus air space, and makes a good-looking building. The shed-roof type is cheaper but not so good looking.

The semimonitor and monitor types are best for a wide house which has a central alley, as these types allow more sunlight in the house, and are commonly used for large brooder houses. The semimonitor house usually faces south. The monitor type of roof is frequently used on buildings facing east and west. Great care must be taken in both these types of houses to avoid drafts.

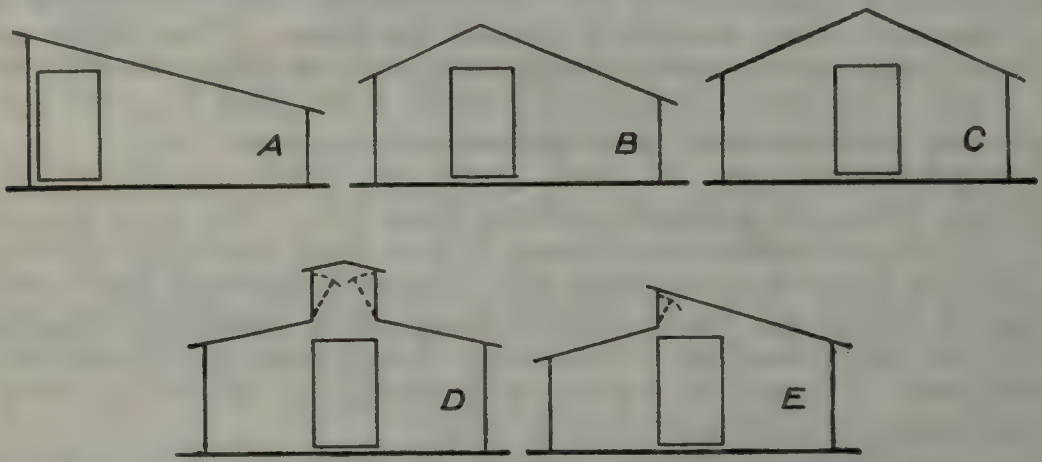


FIG. 8.—Types of roofs of poultry houses. A, shed; B, combination; C, gable; D, monitor; E, semimonitor

The gable roof is used extensively for two-story buildings, for brooder houses, and for incubator cellars. This style of roof is usually ceiled at or slightly above the eaves, or the loft may be filled with straw or some other absorbent material, which tends to keep the house dry and warm. If straw is used there should be an opening in each gable to allow air circulation.

FRONT AND REAR

A house with the entire front open is commonly used in the South. One in which from one-fourth to one-third of the front is curtains and windows is used in the northern part of the United States. Curtains and windows make up from one-third to one-half of the front of the house in the sections between these two extremes. The openings in the front are covered by glass and muslin curtains, so that the amount of open space can be varied according to the season and weather conditions. Glass is most essential in the North, and some glass in the front is desirable in all but open-front houses.

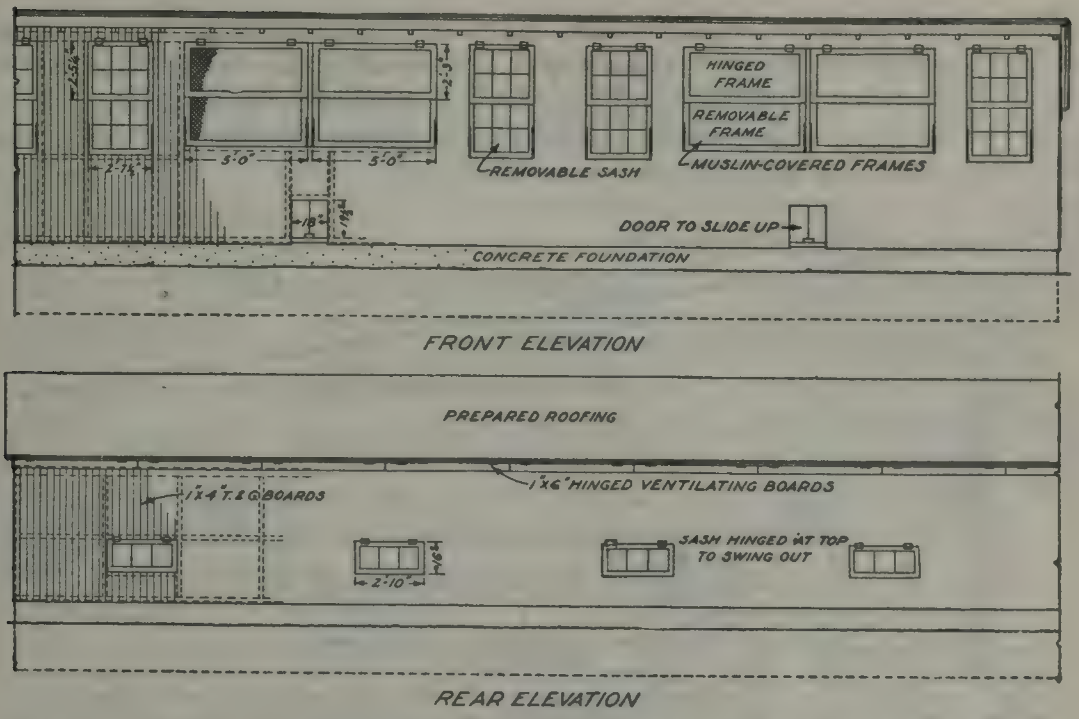


FIG. 9.—Front and rear elevation of shed-roof laying house, 20 by 80 feet, capacity 200 to 250 hens. (See figs. 10 and 11)

The amount of glass or curtain used in the front of the house may be affected by the use of artificial heat in the laying house. Heating laying houses during the cold, winter weather with a hot-water-pipe heating system is practiced by some poultrymen, and in such cases there are usually fewer and smaller curtain openings in the south wall of the house. In case heat is used, the house should be well constructed, so that an even temperature can be maintained readily.

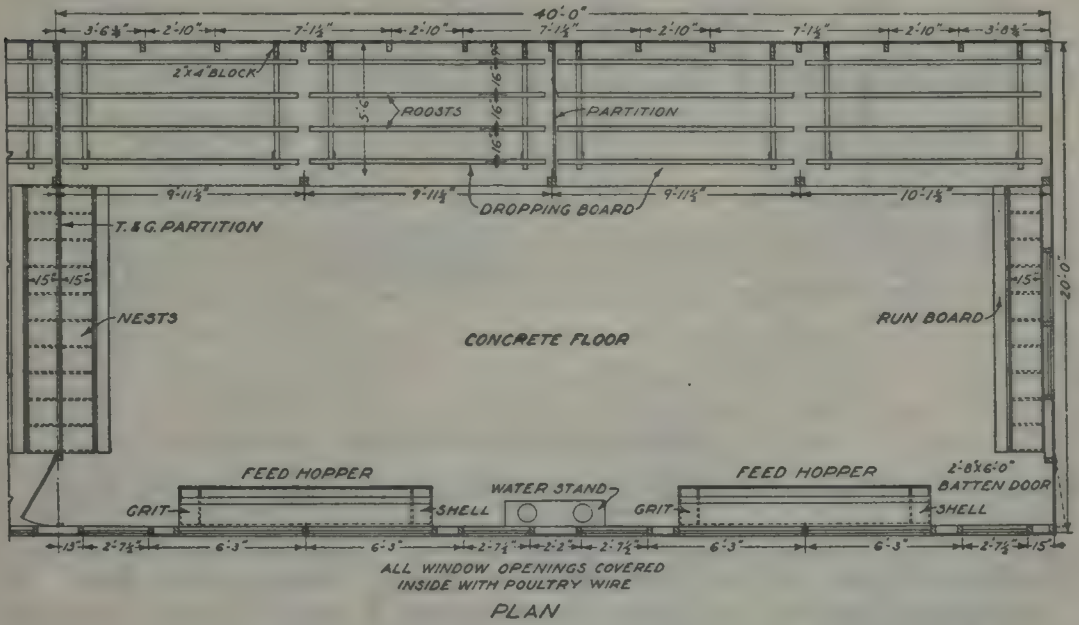


FIG. 10.—Plan of shed-roof laying house shown in Figure 9. This house is 20 feet wide and can be built any length desired

Wooden lowers or inclined slats are used sometimes as wind bafflers in the front of the poultry house, providing an opening through which the air can always circulate without allowing rain to beat into the house. The main objection to these shutters is that they shut out sunlight and are not adjustable.

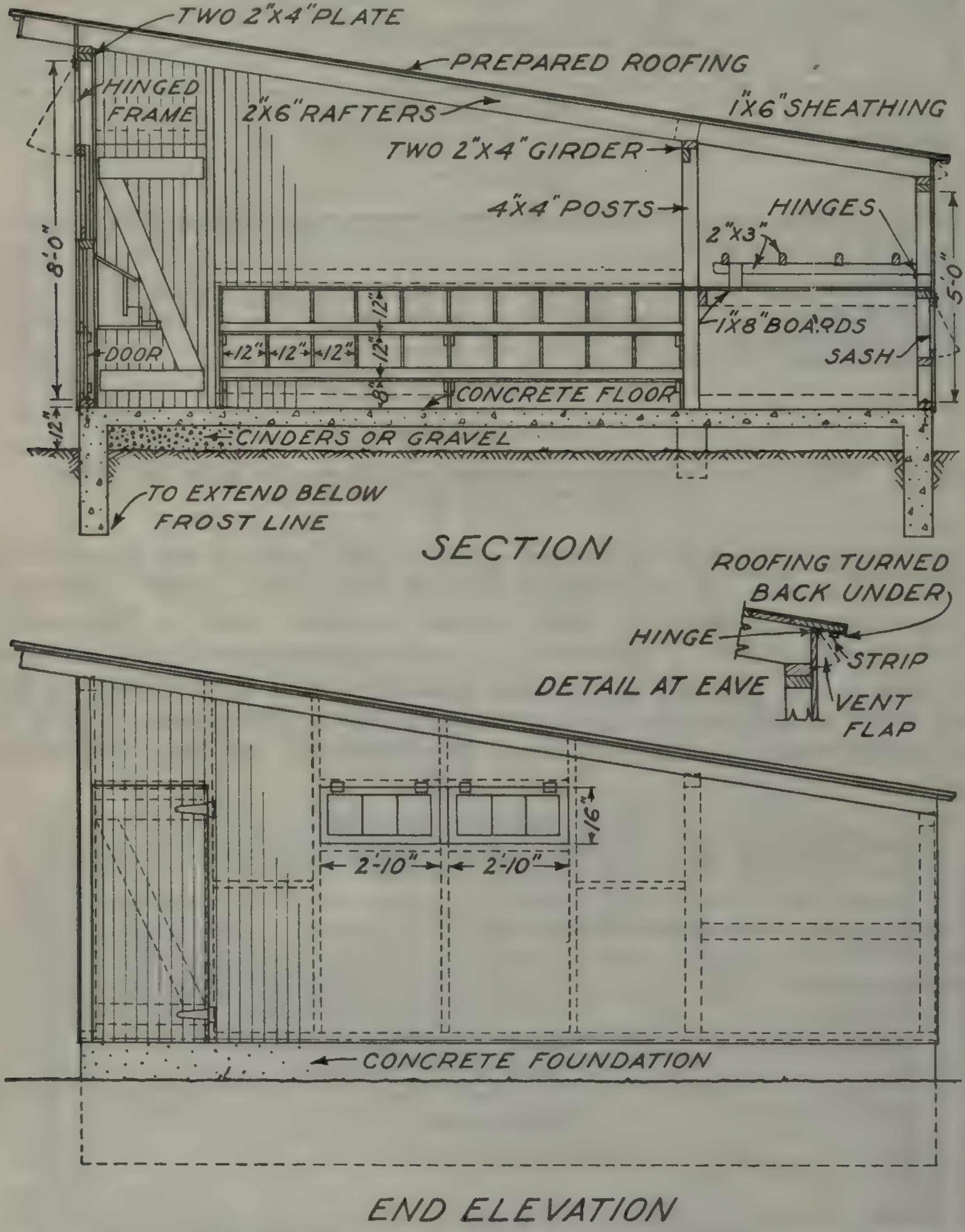


FIG. 11.—Section and end elevation of large shed-roof laying house shown in Figures 9 and 10

Windows in the rear of the poultry house, between the floor and the droppings boards, as shown in Figures 9 and 11, are desirable in wide houses. They let more light in on the floor and help to keep the litter better distributed, as hens always scratch the litter away from the light.

A weather shield from 2½ to 3 feet wide, extending downward like an awning at an angle of 45° from the top of the front, prevents rain from beating into the house. Such shields are particularly good where prevailing rains come from the south.

In order to give extra ventilation in hot weather, in the latitude of Washington, D. C., and all places south of there, an adjustable ventilator opening should be made in the rear of the house. This opening is usually made the entire length of the house, between the plate and the eaves. It must be made so that it can be closed tightly in cold weather. Such an opening is shown in Figures 9 and 11.

A large area of glass in the front of the house makes the house warm during the day and cold at night, as glass radiates heat very rapidly. Unbleached muslin, a light weight of duck cloth, and burlap are used for curtains in the fronts of poultry houses. This cloth should be thin enough to allow a slow circulation of air without a draft, but the object is defeated by using too heavy a grade of duck or by oiling or painting the cloth.

The front of the house should be high enough so that the windows or openings will allow the sun to shine well back into the house in winter. The depth which the sun's rays shine on the floor of the house in the vicinity of Washington, D. C. (latitude 40° N.) on January 1 is given in the accompanying table.

Height of top of windows	Depth of sunshine	Height of top of windows	Depth of sunshine
Ft. in.	*Ft.*	*Ft. in.*	*Ft.*
3 6	8	6 2	14
4 5	10	7 1	16
5 4	12	7 11	18

The arrangement of the windows and openings over which duck cloth or burlap is used is a very important matter because they should not only provide for ventilation and proper lighting of the house but they should be so arranged that the greatest amount of direct sunlight has access to the inside of the house when the windows can be opened and the duck cloth or burlap curtains raised. Direct sunlight is very beneficial in keeping the hens in good health and in promoting the efficient use of minerals which the birds consume. The ultra-violet rays of the sunlight do not penetrate glass to any extent and duck cloth or burlap only to a slight extent, so that, whenever possible, without causing drafts, the front of the house should be opened and the windows and curtain openings should be where the maximum amount of direct sunlight may reach the floor of the house. A number of glass substitutes are on the market, but at present sufficient investigational work has not been conducted to determine their efficiency in transmitting ultra-violet rays.

FLOOR

As to what kind of floor is best depends on the size and use of the house, the slope of the land where the house is to be built, and the soil.

Concrete floors usually are the best for long, permanent buildings, brooder houses, incubator cellars, and all permanent or stationary houses. Concrete floors are easy to clean, very sanitary, rat proof, and comparatively inexpensive where gravel and sand are cheap. Keep concrete floors well bedded with straw or some kind of litter, especially in winter, so that they will be dry and not too cold.

Floors may be made of lumber when the floor level is from 1½ to 3 feet above the ground, or where the land is very uneven or sloping. Board floors too close to the ground make rat harbors and soon rot out. They should be high enough from the ground to let dogs under and to permit circulation of air to keep them dry. Portable houses commonly have board floors.

A dirt floor may be used on very light, sandy, dry soils, especially for small, or colony, henhouses. Dirt floors should be from 2 to 6 inches higher than the outside ground surface. It is advisable to take out the old dirt once a year and replace it with fresh sand or fine gravel and earth. Dirt floors not only harbor rats but are very dusty when the hens are scratching vigorously, and the litter does not last nearly so long as on either a concrete or wood floor.

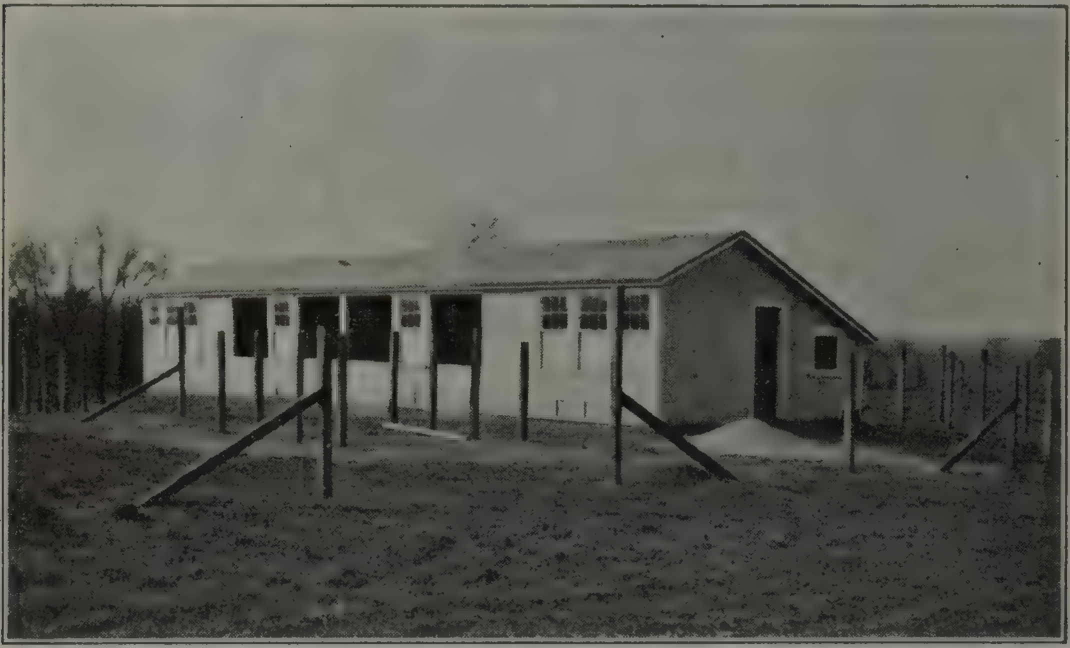


FIG. 12.—A Massachusetts house with good provision for lighting and ventilation. The yards in front enable the house to be used as a breeders' house

PARTITIONS

Partitions in long laying houses are necessary to break possible drafts; the lower 3 feet of the partitions may be solid and the upper portion wire netting, or solid partitions may be used. Partitions extend across the house every 25 to 40 feet, depending on the length of the house.

There should be solid partitions 20 feet or less apart, extending from the back wall of the house at least as far as the front edge of the droppings boards and from droppings boards to roof. This prevents a draft on the birds when on the roost at night and also keeps the birds from overcrowding in one section of the roost.

ROOSTS AND DROPPINGS BOARDS

The interior fixtures of the pens should be simple, inexpensive, and easy to clean. Roosts and droppings boards may be made removable, but satisfactory results are also secured if they are made permanent, with as few cracks and hiding places for mites as possible. The use of carbolineum (anthracene oil) or a wood preservative of this nature on the roosts and roost supports makes it unnecessary to make the fixtures removable except in the South.

Roosts are usually placed next to the end or back walls, 6 to 8 inches above the droppings boards, while the latter are from 20 inches to about 3 feet above the floor. All roosts should be on the same level; otherwise the birds will crowd and fight to get on the highest. Scantlings 2 by 3 inches or 2 by 4 inches with the narrow surface up and upper edges rounded off make good roosts. By hinging the roosts to the back of the house the droppings boards may be readily cleaned, and this arrangement also makes it easy to properly disinfect both roosts and droppings boards. Seven inches of roost space per fowl should be allowed for Leghorns and 10 inches for Plymouth Rocks or birds of that size, while larger fowls require still more space. As many roosts should be used as are necessary to accommodate the fowls comfortably, two roosts generally being used in narrow houses and three, four, and sometimes five in wide houses. Roosts should be placed about 13 inches apart for Leghorns and 15 inches apart for Plymouth Rocks, but the outside ones may be within 10 inches of the edge of the droppings boards.

It is a good practice to place wire netting immediately beneath the roosts to prevent the hens from picking at the droppings. This prevents the hens from consuming many worm eggs frequently contained in the droppings.

MATERIALS FOR BUILDING

Wood is the cheapest and most commonly used material for building poultry houses. A building constructed of wood can be moved, torn down, or changed more readily than one constructed of hollow tile or concrete. Any durable lumber available may be used. Second-hand lumber or lumber from large packing boxes may be used for building small houses. The lumber for the outside construction should be well seasoned; otherwise the shrinkage will leave cracks in the walls.

Hollow tile makes a good poultry house, and can be bought in some sections at a price which, considering its durability, compares favorably with the cost of wood. This construction is well adapted to incubator cellars and brooder houses or to any buildings requiring double walls and good insulation, though it is not commonly used for small poultry houses because of the higher cost. Houses made entirely of solid concrete are cold and damp.

CONSTRUCTING THE HOUSE

FRAMEWORK

The framework consists of the sills, which support the building; the studs or uprights, which rest on the sills, the plate, which is on top of the studs, and the roof rafters, which rest on the plates.

Wooden floors should be from 1½ to 3 feet above the ground. Concrete floors are laid directly on the ground, though the site should be elevated enough so that there is good drainage away from the building.

The sills are placed on wooden posts, stones, or concrete supports, or directly on top of concrete walls. Wooden posts should be from 6 to 8 inches in diameter, placed 6 to 8 feet apart, and 2 to 3 feet in the ground or below the frost level. Cedar, locust, chestnut, redwood, and cypress are preferable to most other woods. Concrete posts may be used in place of wooden posts, and are much more durable.

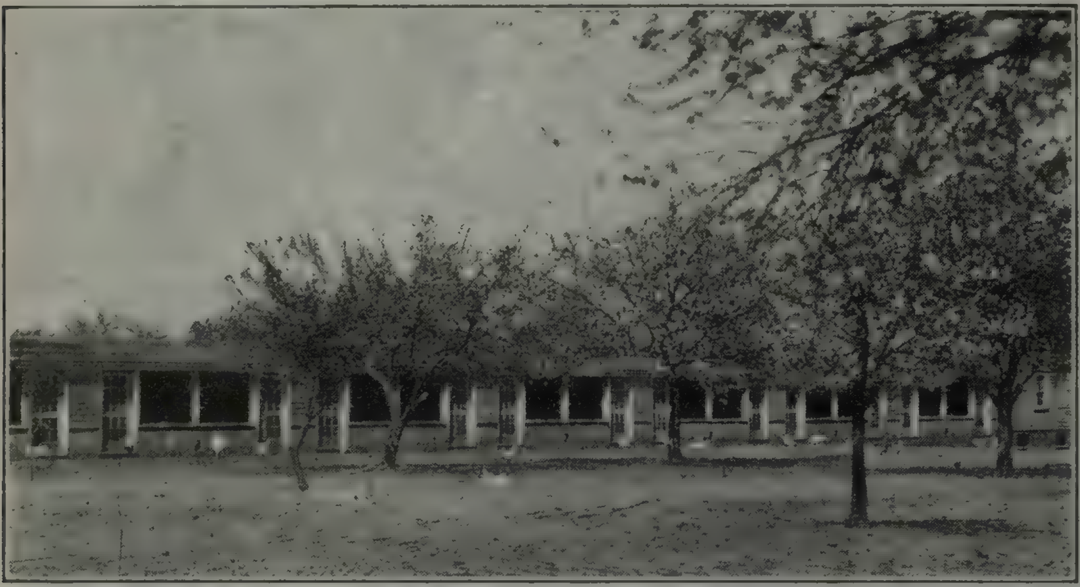


FIG. 13.—A continuous type of laying house used successfully in many parts of the United States

The sills may be either 2 by 4 inches or 4 by 4 inches depending on the size and construction of the building. Sills 2 by 4 inches are heavy enough for colony houses or those of light, single-wall construction if sufficiently supported, while sills 4 by 4 inches are used for larger buildings and for houses with double walls. Sills 4 by 6 inches are used in 2-story henhouses or other large poultry buildings, and should be set on edge, unless on a concrete or stone wall, when a lighter sill may be used and laid flatwise. Concrete walls are commonly used as foundations for large poultry houses, with a 2 by 4 inch sill, which is bolted to the walls. The posts or supports must be set close together if light sills are used.

Runners 3 by 4 inches or 4 by 6 inches are used as sills for portable houses, which require heavy framework. Portable houses which are to be moved on runners must be braced extra well in the corners to stand the strain of moving.

Floor joists may be of 2 by 4 or 2 by 6 inch lumber, depending on the span. They should be from 16 to 20 inches apart. If the span is over 10 feet a center support should be used for 2 by 4 joists.

To square the corners of a poultry house, fix one line or side of the proposed house. With this as a base, locate the other corner posts by using the 6, 8, and 10 foot combination, measuring 6 feet from one end of the fixed line and 8 feet from the same end at right angles. The angle between the two lines is fixed by a rule 10 feet long running from the 6-foot mark of the fixed line to the end of the 8-foot line, thereby making a square corner. A triangle whose sides are 6, 8, and 10 feet long, respectively, contains a right angle opposite the diagonal side.

The sill in small buildings may be made level by driving a stick at one corner of the house, to which a straightedge or a long, straight stick is nailed at the desired height of the posts or sill. A spirit level is used on this straight edge to make the posts at the right height or to make the sill level. A transit is generally used in laying out large buildings.

The studding is toenailed on the sill and should be set plumb with a spirit level and braced well until sheathed. The studding is set from 2 to 4 feet apart for the rear walls and is placed to fit the windows, curtains, and doors in the front and ends. The studs should be placed so that the lumber will cut with little waste. Less studding is required if the building is boarded up and down rather than horizontally, as in the former case only a few studs with cross studding or ties are required. Studs 2 by 4 inches are commonly used, except that in large houses the corner studs are generally doubled, making them 4 by 4.

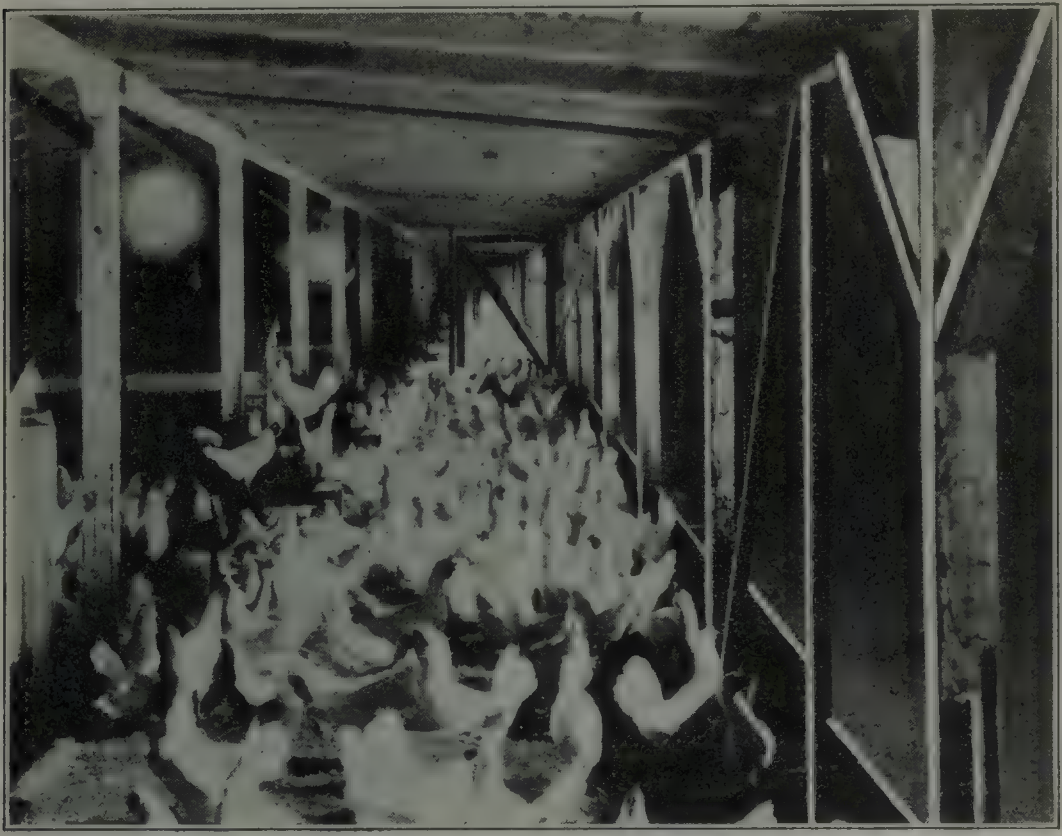


FIG. 14.—House such as is used on the Pacific coast. Note the open front, which is common in many parts of California, though a curtain is frequently used in Oregon and Washington

Sills and plates are halved or spliced and nailed together at the joints or ends, which should be made over a post or stud. The plates are spiked at the top of the studding and are made of 2 by 4 inch scantling, laid flat on top of the studs, or 4 by 4 made by spiking two 2-by-4s together.

Rafters may be 2 by 4 inch or 2 by 6, the 2-by-4's being used only in light buildings where the clear span is not more than 12 feet and 2-by-6's for longer spans and in climates where roofs have to bear much snow.

It is advisable to use purlins in buildings where rafters are more than 12 feet long. Purlins are usually made of 2 by 4 or 2 by 6 inch material set on edge on posts to support the roof. They are placed lengthwise of the house about midway the length of the rafters, which rest on them. In a deep house which has a wide droppings board the purlin may be placed at the front edge of the droppings board, so that the posts supporting the purlin will not be in the way in the pens. (See fig. 11.)

In roofs that form a ridge a board may be placed between the ends of the rafters to keep the ridge straight and even, but this is not necessary in most poultry houses. Collar beams or crossties 1 by 6 inches are used to prevent the spreading of the rafters on gable or combination roofs. They should be placed as low as possible on the rafters, so as to stiffen the frame, but not so low as to interfere with head space. If the hens roost on them, cover the space between them and the rafters with wire netting.

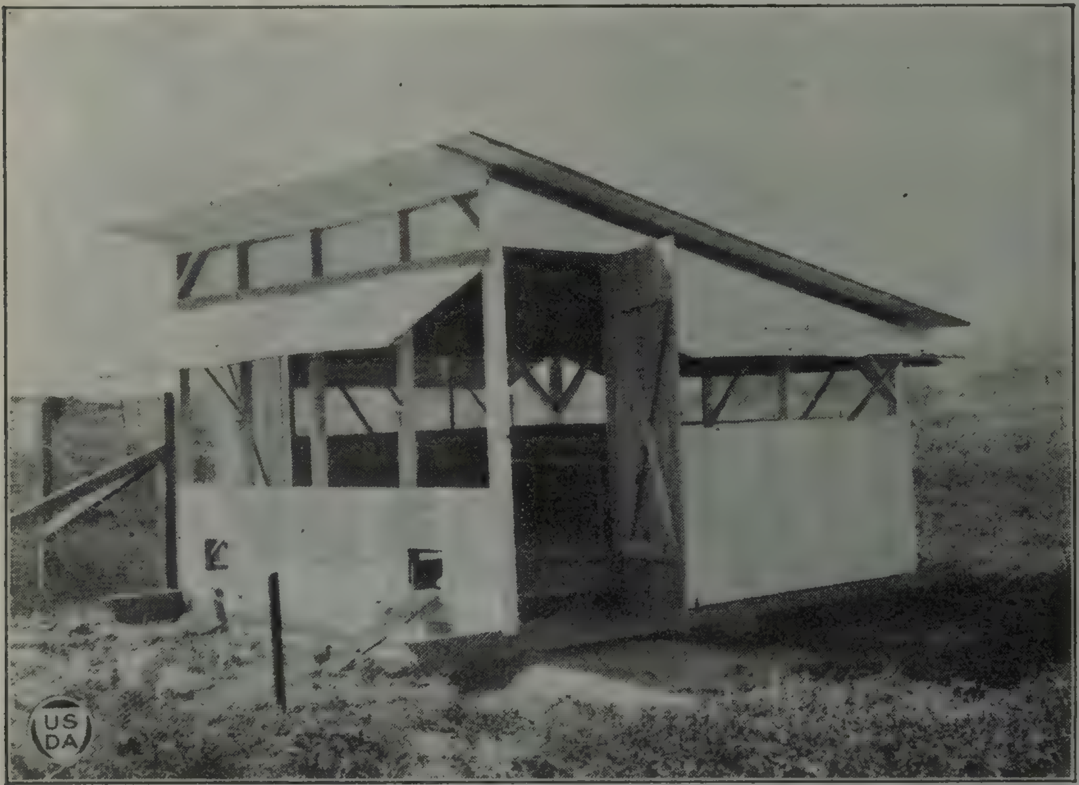


FIG. 15.—A type of house used in the South. The illustration shows the method of providing adequate ventilation during warm weather

In erecting the rafters one pair may be set in position and the rest marked from these. They should be notched only deep enough to make a snug fit and to provide good nailing on the plates, because deep notching weakens them. Rafters are usually spaced 2 feet apart, from center to center, so that the roof boards will cut with minimum waste.

FLOORS

Most concrete floors are damp and cold and therefore must be heavily covered with litter. This is especially true of concrete floors laid directly on the ground. It is absolutely essential to keep the floor of the poultry house dry.

The best concrete floors are made by first putting down a firmly tamped foundation of cinders, broken stone, or gravel not less than 6 inches thick and then laying on it from 3 to 4 inches of concrete. A layer of tarred building paper, lapped and cemented with tar at the seams, may be laid between the stone foundation and the concrete to prevent moisture from coming through the earth and concrete and making the floors damp. Care should be taken not to break holes in the paper. Detailed information on the use and mixing of concrete is given in Farmers' Bulletin 1279, Plain Concrete for Farm Use.

Wooden floors, in most parts of this country, are usually made of one thickness of matched flooring. In the extreme northern sections they are generally doubled to make them tight and warm, in which case the lower layer of boards is usually laid diagonally, and building paper is placed between the floors.

WALLS

The walls of most poultry houses are built of siding or flooring nailed directly to the studs. In the North, siding is usually placed over sheathing, making a wall of two thicknesses of boards, with building paper between. Boards 10 to 12 inches in width, placed vertically, with the cracks covered with battens 3 inches wide, are sometimes used for the wall. Matched lumber seven-eighths inch thick placed vertically is used extensively in poultry-house construction and makes a very satisfactory wall without any other covering. Lumber 2½ to 6 inches wide is usually used for this purpose, as wide boards are apt to shrink so much as to leave cracks.

The lowest board on the walls should extend over the top of the sill to cover the joint. A tight joint should also be made at the eaves, either by cutting the rafters off even with the rear wall and covering this joint with good roofing paper or by filling in the space between the rafters with boards. A wide board may be used as the first board on the rafters, allowing it to project from 2 to 4 inches beyond the rear wall, to protect the rear wall of the house. The sheathing should be from 6 to 8 inches wide and should be laid so as to break joints in order to strengthen the building. Siding is usually laid from the bottom upward and also with joints broken. A shutter may be placed just under the eaves on either the outside or the inside of the rear wall for summer ventilation (figs. 9 and 11). The essential point is to have a rear wall which is tight near the roosts, to prevent drafts from striking the birds.

ROOF

Prepared roofing, laid on wide matched sheathing, is ordinarily used for covering the roof. Wooden shingles are used in only a few sections of the country, principally on the Pacific coast. One or two ply roofing material is usually used on the sides, and one, two, or three ply roofing on the roof, the choice varying with different styles and grades of manufacture. This prepared roofing may be had in the form of shingles or in rolls. Directions and materials for laying are supplied with the roofing. The sheathing should be planed on one side and laid close together, with the surfaced side up to present a smooth surface for the prepared roofing. Sheathing paper is sometimes used between the sheathing and the roofing material. Prepared roofing may be used on roofs which have a slope of 1 inch or more to the foot.

Such roofing will last longer on a roof which has considerable slope than on a roof which has only a slight slope. A shed roof is the easiest one to cover with prepared roofing, which lasts especially well on this type of roof because it has a northern exposure and is not so much affected by the sun. The best way to fasten the loose ends of roofing paper is to bend them under the sheathing, fastening the paper with a narrow board. (Fig. 11.)

Wooden shingles may be laid from 4 to 5 inches to the weather on roofs which have at least a one-third pitch, which is a rise of 8 inches to the foot, or a total height equal to one-third of the span of a gable roof or two-thirds of the span of a shed roof. Cedar and cypress shingles are usually laid not more than 5 inches to the weather on walls, and are not generally used on roofs which have a rise of less than 8 inches to the foot. Wooden shingles should be laid on narrow sheathing 3 to 5 inches wide, or on common sheathing, and should break joints at least 1 inch and as much more as possible. The sheathing boards should be spaced about 3 inches apart to allow the roof to dry out quickly. Four bundles of wooden shingles are the equivalent of 1,000 shingles 4 inches wide, and estimates are made on this basis. One thousand shingles laid 4½ inches to the weather will cover about 125 square feet, depending on their size.

ESTIMATING MATERIALS REQUIRED

Lumber comes in even lengths, usually 10, 12, 14, and 16 feet long. It is figured at so much per 1,000 feet board measure (b. m.), which means the number of square feet which the material would cover if it were 1 inch thick. The number of feet, board measure, in dressed lumber is based on the size of the lumber before it is dressed. The width of matched flooring is usually based on the width of the board before it is dressed and before the tongue and groove have been made. To compute board measure, multiply the width in inches by the thickness in inches, and multiply this by the length in feet, and then divide this result by 12. The accompanying table shows the number of feet, board measure, in lumber from 6 to 16 feet long, with a cross section varying from 4 to 16 square inches.

Table of board measure

Length	Area of cross section					
	4 inches	6 inches	8 inches	10 inches	12 inches	16 inches
	Board measure					
Feet	*Ft. in.*	*Feet*	*Ft. in.*	*Ft. in.*	*Feet*	*Ft. in.*
6	2 0	3	4 0	5 0	6	8 0
8	2 8	4	5 4	6 8	8	10 8
10	3 4	5	6 8	8 5	10	13 4
12	4 0	6	8 0	10 0	12	16 0
14	4 8	7	9 4	11 8	14	18 8
16	5 4	8	10 8	13 4	16	21 4

Boards less than 1 inch thick are usually sold by the square foot, the price depending on the thickness of the lumber. In estimating lumber an allowance should be made for waste, adding one-seventh for common sheathing, one-fifth for matched lumber 6 inches wide, one-fourth for matched siding or lumber 4 inches wide, and one-third for matched flooring 3¼ inches wide.

If a working plan or blue print of the poultry house is not available, one should be drawn, using a convenient scale, about one-fourth inch to the foot, showing the ground plan, the front elevation, and the end or a cross section of the house. The bill of materials can be worked up from the drawings.

Wire nails are generally preferred in construction, as they are easier to use than cut nails, although the latter have greater holding power. Use 10 to 20 penny nails for framing, 8 to 10 penny for sheathing, 8-penny for siding, and 6-penny finish or casing nails for clapboarding. Four-penny nails are 1½ inches long, 6-penny are 2, 8-penny are 2½, 10-penny are 3, and 20-penny are 4 inches long. It takes about 5 pounds of 4-penny nails to 1,000 shingles, 18 pounds of 6-penny for 1,000 square feet of beveled siding, 20 pounds of 8-penny and 25 pounds of 10-penny for 1,000 square feet of sheathing, 30 pounds of 8-penny for 1,000 square feet of flooring, and 15 pounds of 10-penny and 5 pounds of 20-penny for the studding in 1,000 square feet of frame wall.

A cubic yard of 1:3:5 concrete will take 4.64 sacks of cement, 0.52 cubic yard of sand, and 0.86 cubic yard of gravel. A cubic yard of 1:2 mortar surface will take 13.48 sacks of cement and 1 cubic yard of sand. A concrete wall can be made entirely of rough concrete, making the wall 6 inches wide and at least 2½ feet high, the top of the wall being level with the top of the floor. The bottom of the wall should go below frost depth.

PAINT AND WHITEWASH

Paint adds greatly to both the appearance and durability of all buildings and appliances. All surfaces should be clean and dry before they are painted. Use a priming coat made of about equal parts of paint and linseed oil and cover with one or more coats of paint, which should be thoroughly brushed into the wood.

Whitewash is cheap and may be used both inside and out. It is made by slaking quicklime in water. The lime should be placed in a vessel and water poured over it, covering the vessel with cloth or burlap, and allowing the lime to slake for one hour. Water is then added to bring the whitewash to a consistency which may be applied readily. Whitewash is spread lightly over the surface with a broad brush, or may be put on with a spray pump.

Interior whitewash may be made in the following manner: (1) Slake 1 bushel of quicklime with 15 gallons of water; (2) beat 2½ pounds of rye flour in one-half gallon of cold water and then add 2 gallons of boiling water; (3) dissolve 2½ pounds of common rock salt in 2½ gallons of hot water; mix (2) and (3), then pour into (1), and stir until thoroughly mixed.

A whitewash for exterior surfaces may be made as follows: (1) Slake 1 bushel of quicklime with 12 gallons of hot water; (2) dissolve 2 pounds of common salt and 1 pound of sulphate of zinc in 2 gallons of boiling water; pour (2) into (1), then add 2 gallons of skim milk, and mix thoroughly. Detailed information on painting and whitewash will be found in Farmers' Bulletin 1452, Painting on the Farm.

ARTIFICIAL LIGHTS

The use of artificial lights in laying houses during the winter months has become a common practice on many poultry farms, especially on the commercial farms in the northeastern section of the country and on the Pacific coast. The use of artificial lights does not increase the annual production of eggs so much as it increases the proportion of eggs laid during the fall and winter months, when egg prices are relatively the highest. The lights are used from about the first of November to the latter part of March.

Experimental work has shown that a good lighting unit is a 40-watt lamp. It should be fitted with a reflector about 16 inches in diameter and the light should be suspended about 6 feet from the floor. This height is necessary in order to light the roosts well; otherwise some of the birds will not leave the roosts until daylight. Place the lights about 10 feet apart; if the poultry house is 20 feet long, two good lights should be sufficient.

The lights can be turned on by hand or automatically, for which purpose special clocks are made. A local electrician should know how to install the lights and set the clock, as well as to make sure that all connections and wiring are safe.

FIXTURES AND EQUIPMENT

A laying house is not complete without fixtures and equipment of various kinds. Fixtures should always be durable and well adapted for the purpose intended. Avoid an excessive use of fixtures; otherwise they will obstruct too much light and tend to make the house much more difficult to keep clean.

NESTS

Nests may be placed on the partition or end walls, but should be high enough above the floor so that the fowls can work under them. They should also be arranged so that the hens can get into them easily. The nests should not be placed under the droppings board if there is any other place where they can be arranged, as placing them there makes the space under the droppings boards dark and makes the nests more likely to get dirty and more subject to infestation with insects. The nests should be from 12 to 14 inches square, depending on the size of the hens, about 12 inches high, with a strip about 4 inches high on the open side to retain the nesting material. One nest should be provided for every four or five hens.

It is highly advisable to have darkened nests built out from the wall so that the birds enter the nests from the rear, the front of the nests being made of a long door which can be opened for gathering the eggs. (Fig. 16.) The advantage of using darkened nests is to prevent the egg-eating habit.

The use of trap nests is essential in breeding poultry for both egg production and exhibition where pedigree records are used in selecting either the males or females. Trap nests are of value in weeding out poor layers and increasing the average egg yield of a flock by selecting and breeding, but are not generally used on account of the large amount of labor required to operate them. The use of trap nests enables the poultry man to learn more about the qualities of good and poor layers than can be done in any other way. Some poultry breeders trap nest their pullets during their first six months of laying and use this as a basis in selecting their breeders for egg production.

One trap nest should be provided for every 4 hens kept in flocks of 50 or more, and one for about every 3 hens in smaller flocks. There are several styles of trap nests that give satisfaction. Several manufacturers of trap nests sell the fronts separately, so that by purchasing them it is a very simple matter to make the nest and attach the trap to it.

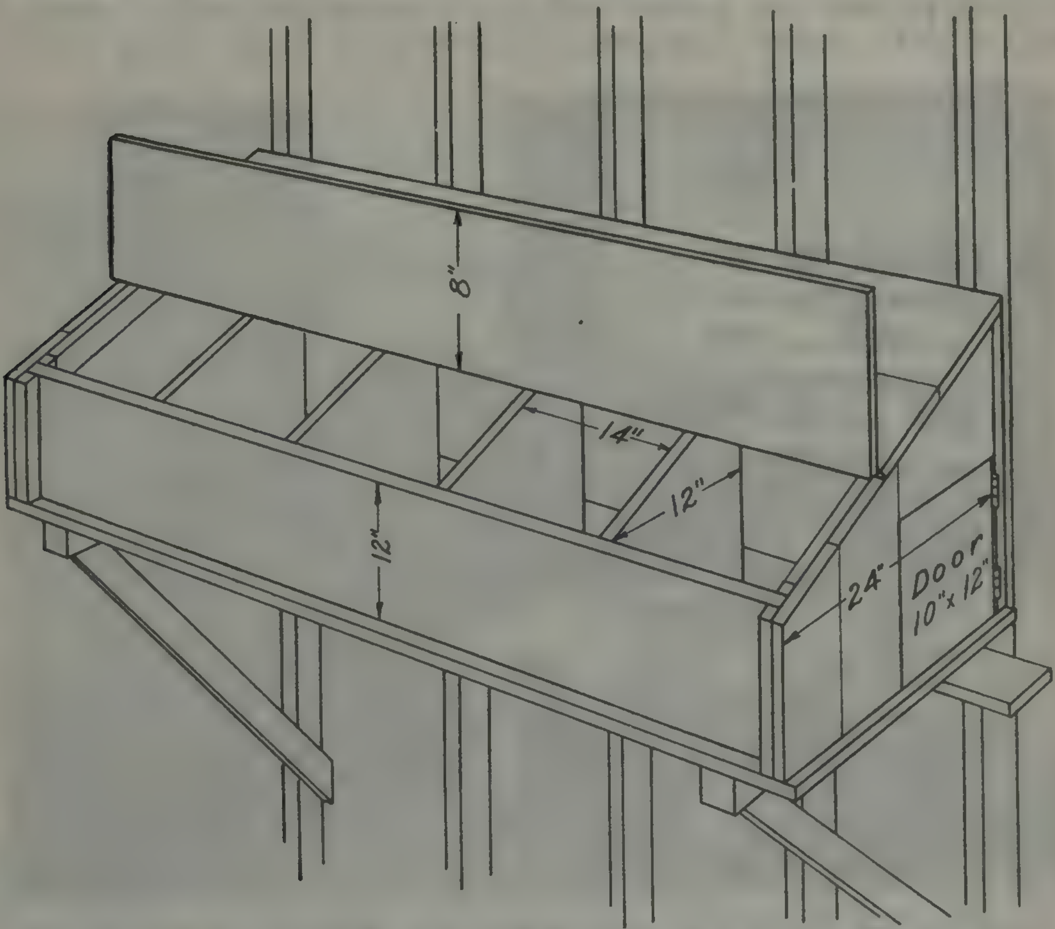


Fig. 16.—Simple, convenient, and practical wall nests, so arranged that hens enter from the rear. The door is opened for gathering eggs; otherwise the nests are dark, which tends to prevent the egg-eating habit from developing. The front board is removable for cleaning the nests

DRY-MASH HOPPERS

Dry-mash hoppers should be so constructed as to hold a sufficient quantity of mash to last for at least a few days, and they should also avoid any wasting of the mash. The hopper should be large enough to afford plenty of feeding space for the members of the flock; a hopper which allows the hens to eat from both sides should be 1 foot long for every 10 birds. One of the most satisfactory indoor dry-mash hoppers is shown in Figures 17 and 18. A satisfactory type of outdoor hopper is shown in Figures 19 and 20. It should be moved frequently, however, or it may become a harbor for rats.

GRIT AND OYSTER-SHELL HOPPERS

A simple and convenient type of hopper that may be used either for grit or oyster shells is shown in Figure 21. The grit or shell is easily accessible and the hopper can be located in any convenient place.

DRINKING STANDS

The drinking vessels for water and skim milk should be supported on a platform about 12 to 18 inches off the floor. Such an arrangement tends to keep the drinking vessels and contents in a much more sanitary condition. The platform should be large enough for the the birds to stand on it comfortably while drinking, and it should be made of slats, so that droppings will not accumulate. (Fig. 17.) In sections of the country where the water does not freeze in winter water hydrants and troughs are installed inside the house, and the flow is so arranged that by allowing the water to run a drop at a time the fowls are insured a continuous supply of fresh water. This arrangement is a great saver of labor; in fact, few poultry men realize the amount of labor annually required in watering a flock of chickens.

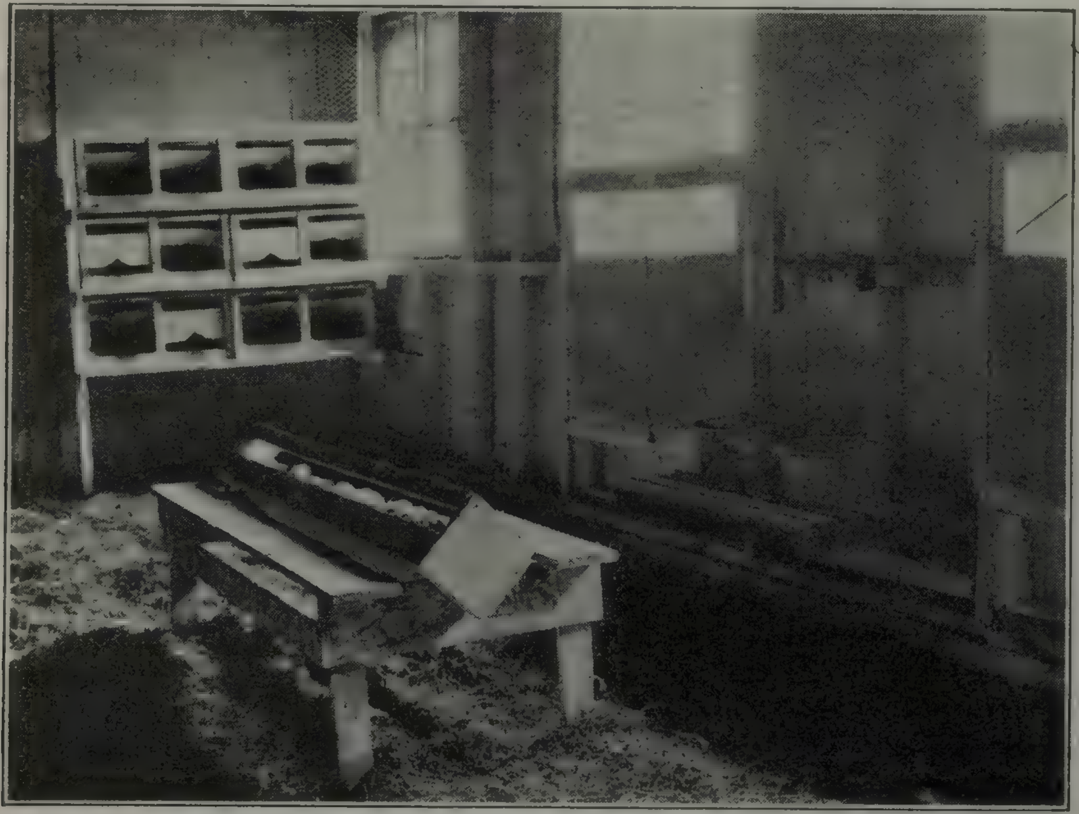


FIG. 17.—A good dry-mash hopper for laying hens. Note also the drinking stand at right and trap nests in rear

BROODY COOPS

A suitable place to "break up" broody hens is necessary on a poultry plant. It may be quite simple in design, but should be so arranged that the broody hens can be fed and watered regularly, and the bottom of the coop should be made of slats so that air will circulate freely beneath the hens. A good style of broody coop is illustrated in Figure 22, and can be placed on the inside of the house in the North and on the outside in the South.

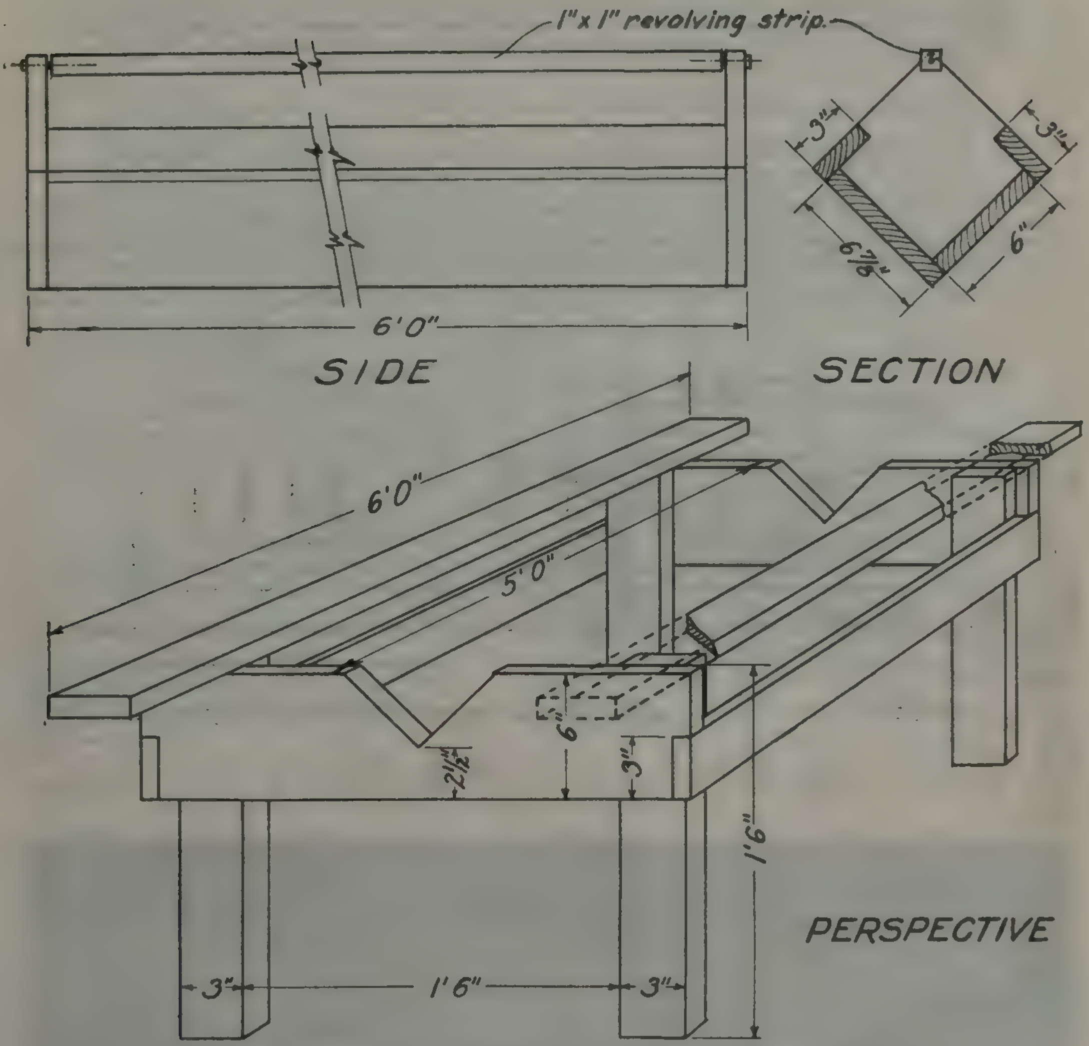


FIG. 18.—Plan of dry-mash hopper shown in Figure 17

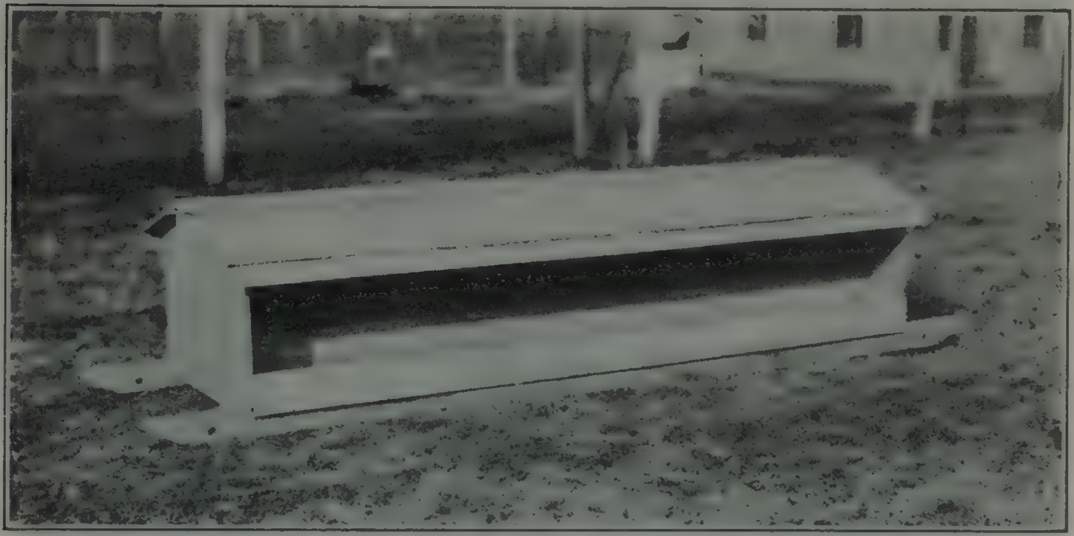


FIG. 19.—An outdoor dry-mash hopper

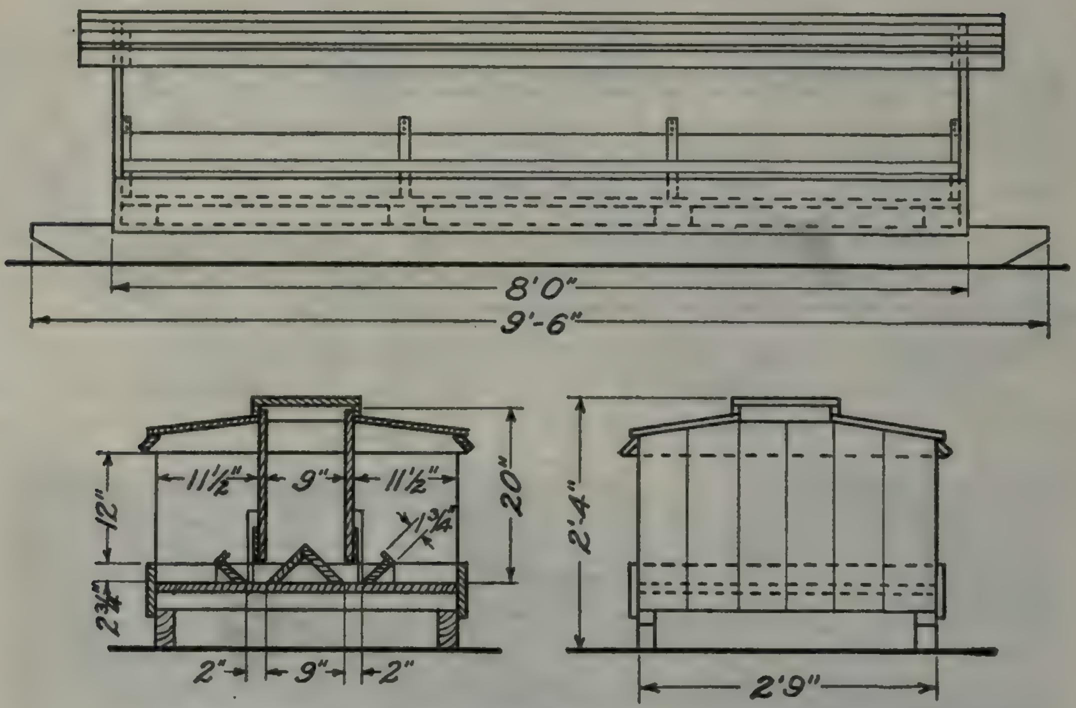


FIG. 20.—Cross section of dry-mash hopper as shown in Figure 19

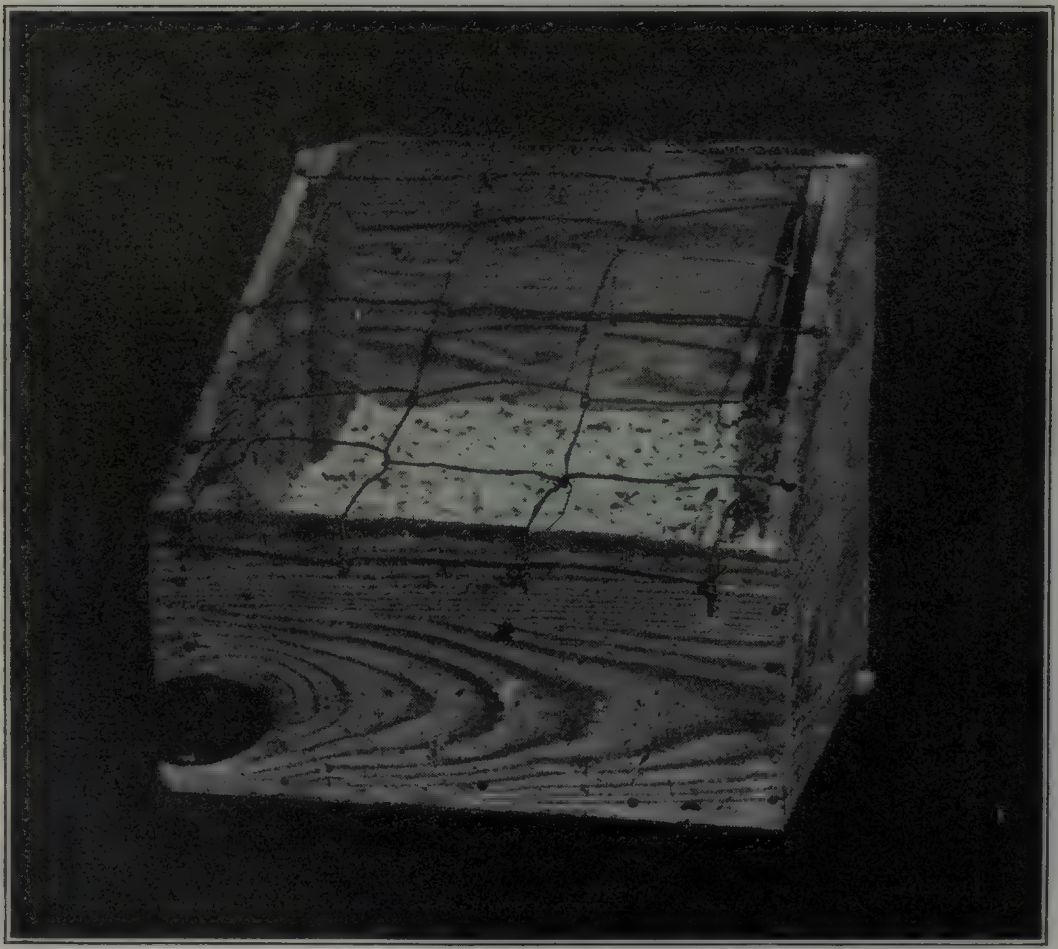


FIG. 21.—A hopper for grit or oyster shells

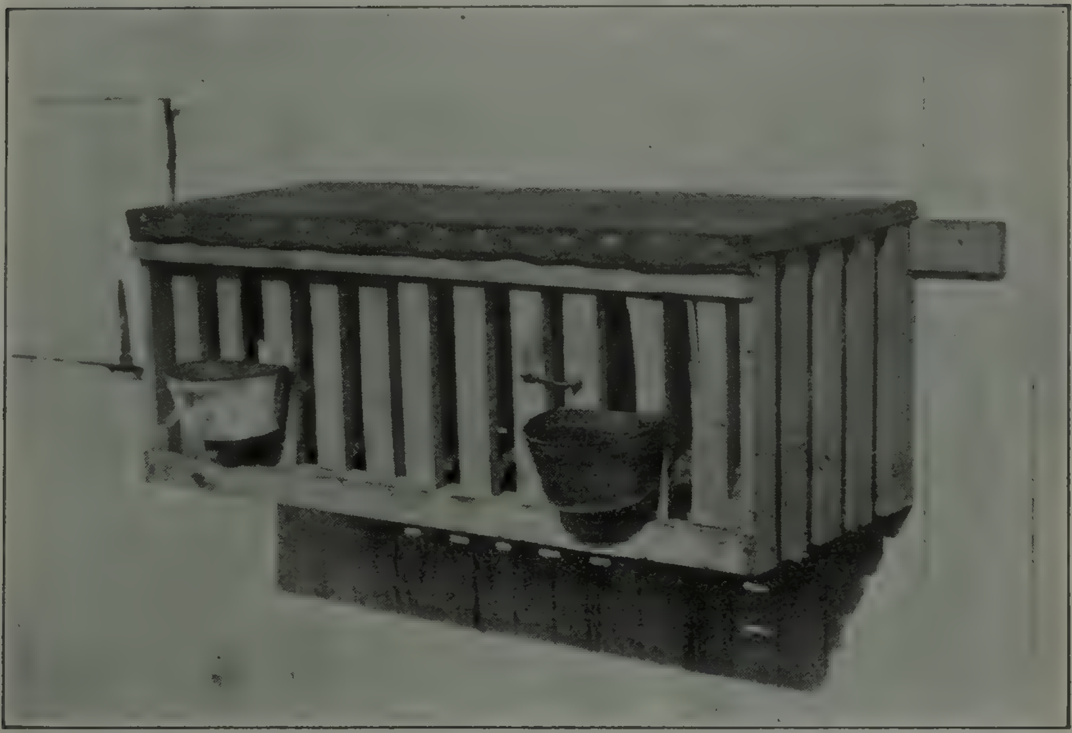


Fig. 22.—A convenient broody coop for use inside or outside the laying house. The bottom is made of 1-inch slats running lengthwise with 1-inch space between them to allow droppings to pass through and to allow air to circulate under the body of the broody hen

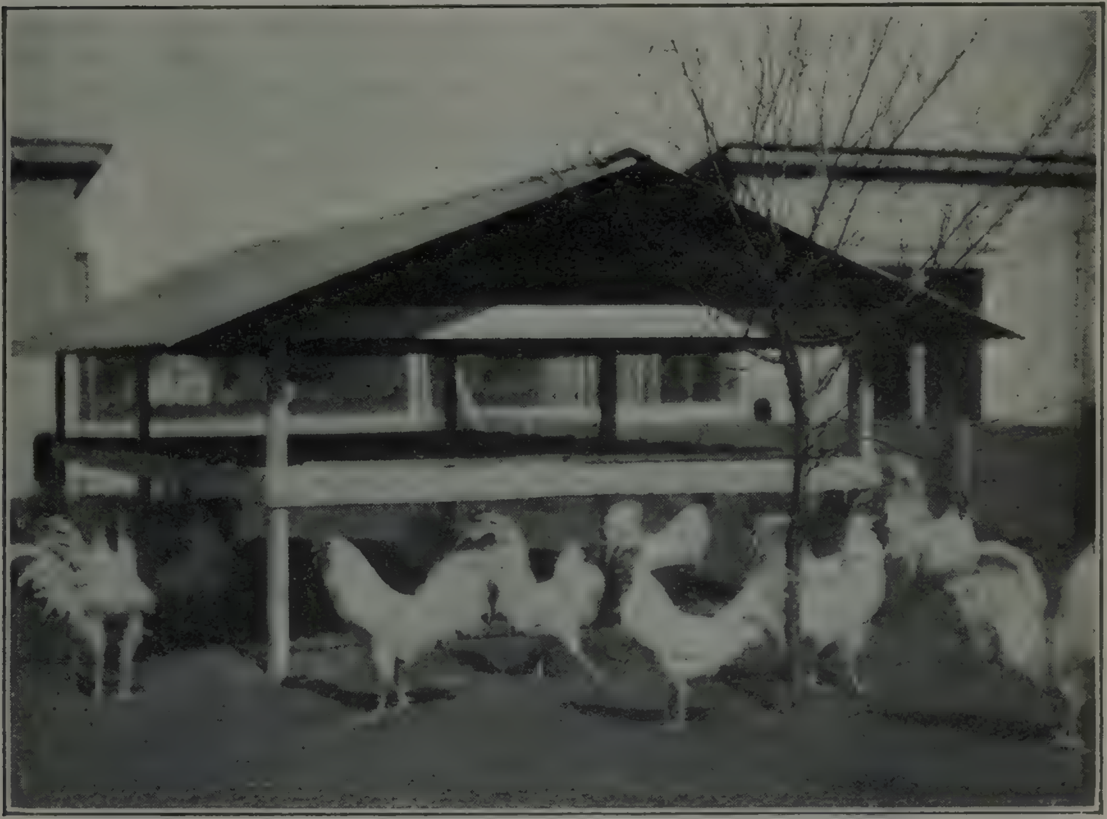


Fig. 23.—A good shade device for hot weather

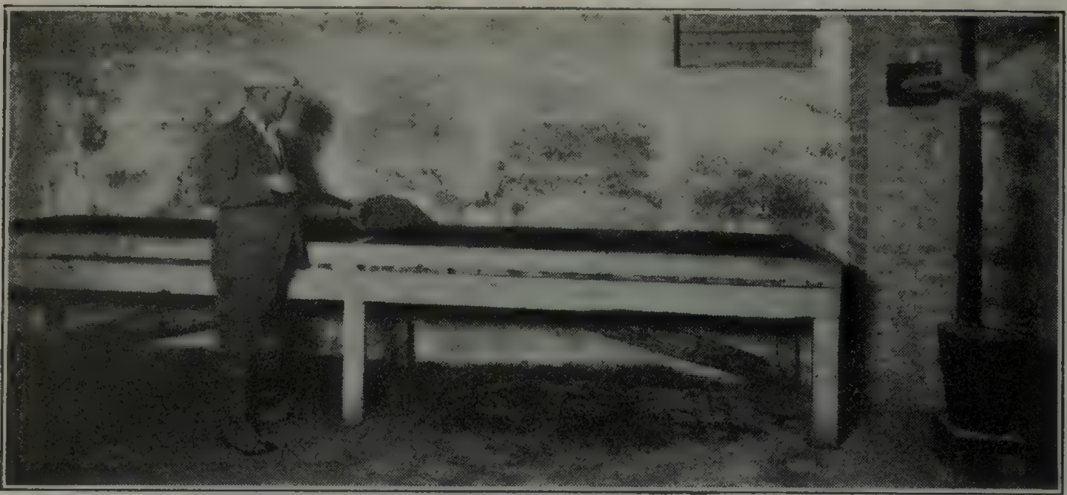


Fig. 24.—A very simple arrangement for sprouting oats. The oats are turned with a shovel. The bottom of the table is perforated with half-inch holes. The stove is used to maintain a temperature of about 70° F.

SHADE DEVICE

Where natural shade is lacking, for either growing or adult stock, some form of shade device should be constructed so that the birds may obtain relief from direct exposure to the sun's rays. A simple and satisfactory shade device is shown in Figure 23.

OAT SPROUTER

There are a number of devices on the market for sprouting oats, and some of them have given satisfaction, though many of them involve too much labor if a quantity of oats is to be sprouted or germinated. One of the simplest and most satisfactory kinds of oat sprouter is a table about 2 feet high, 2 feet wide, and as long as may be desired, the bottom of the table being perforated with holes and the sides of the table being about 4 inches high. (Fig. 24.) The quantity of oats required for a day's feeding is soaked in warm water in

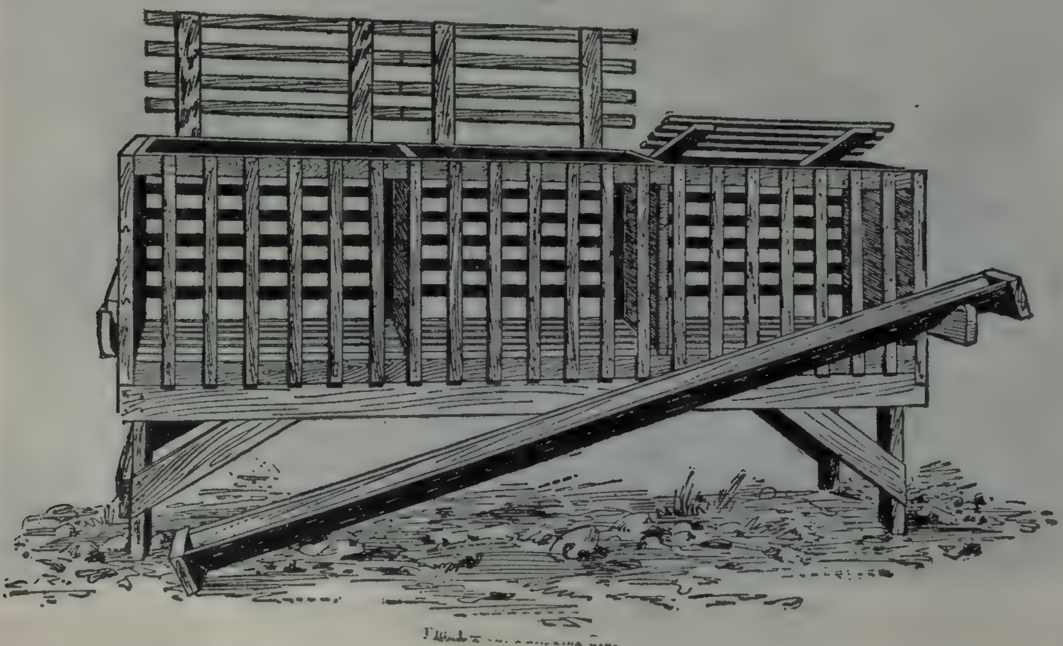


Fig. 25.—A satisfactory fattening crate for farm use

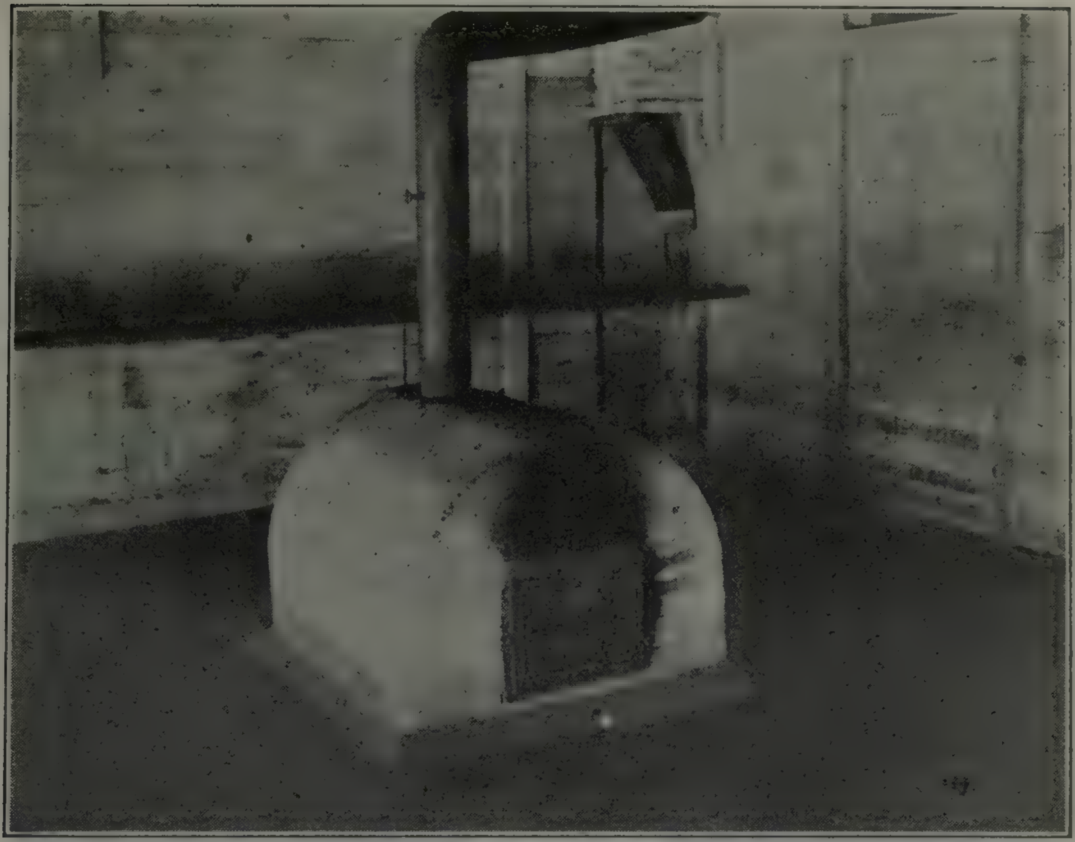


FIG. 26.—At large poultry plants an incinerator provides a satisfactory way of disposing of dead birds. The incinerator shown above is 3 by 3 feet and 2½ feet high at center. There is a small draft door beneath the larger door

a sack for 24 hours and then emptied on to one end of the table and spread out to a thickness of 2 to 3 inches. From day to day the oats are turned over with a shovel and watered, moving each day's supply along the table until they reach the lower end, when they are taken out to be fed. The table should be kept in a room where the temperature is about 70° F.

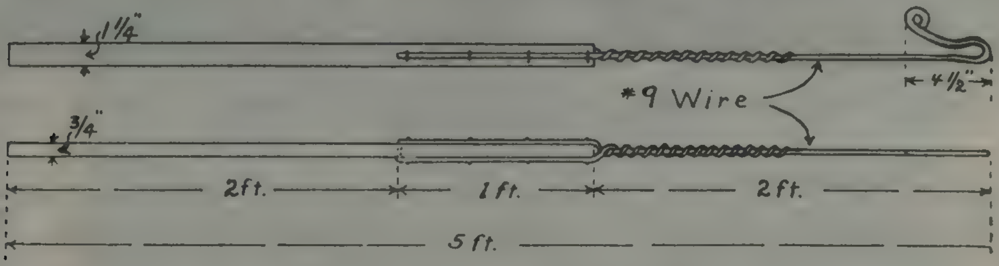


FIG. 27.—Working plan of catching hook

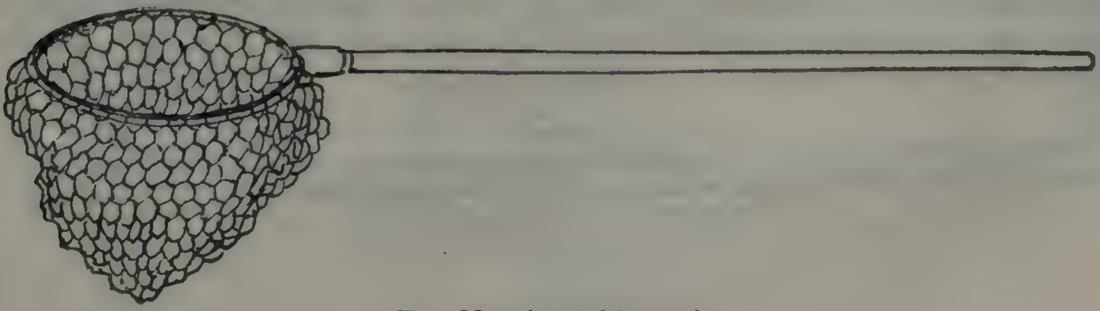


FIG. 28.—A catching net

FATTENING CRATES

The fattening crate is made of laths nailed to a stout framework, with a few light boards for the ends and partitions. The crate should be 6 feet long, 18 inches wide, and 18 inches high. The laths on the top, back, and bottom run lengthwise of the crate and are placed 2 inches apart; care should be taken to have front and back slats on the bottom at least 1 inch from the front and back sides of the crate, so that droppings may pass through and not accumulate. The laths on the front of the crate run up and down and are placed 2 inches apart, so that the fowls may eat from the trough. A V-shaped trough 3 inches deep and 5 inches wide at the top is placed on brackets which are placed 4 inches from the bottom of the crate. The crate should stand on legs about 3 feet high. (Fig. 25.)

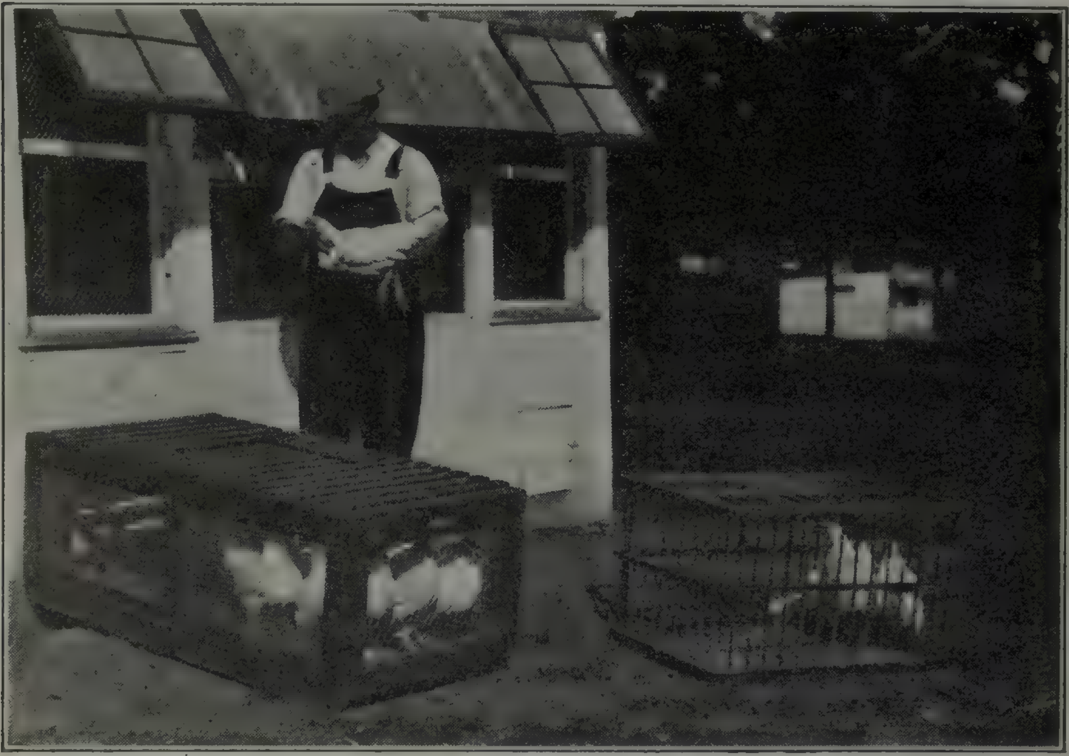


FIG. 29.—A satisfactory crate for culling laying hens. Note the slide doors on the top and at each end

INCINERATOR

On poultry plants carrying several hundred birds usually a sufficient number of chicks and adult birds die each year to make it advisable to have an incinerator. A very simple and serviceable style of incinerator is shown in Figure 26. Other useful articles of equipment are a catching hook (fig. 27), a catching net (fig. 28), and a crate for use in culling laying hens (fig. 29).

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U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1555

PEPPERMINT and SPEARMINT as FARM CROPS

THE CULTURE of peppermint and spearmint and the distillation of oil from these plants in the United States is centralized in Indiana, Michigan, western Oregon and Washington, and in a few other localities where conditions especially favor the crop, but the industry is capable of considerable expansion in these and other localities if greater commercial demands for the oils should develop. The total area of mint under cultivation in the United States is estimated at about 35,000 acres, of which about 10 per cent is spearmint.

Mint culture was first introduced in New York, but declined rapidly there when large areas of fertile muck land in southern Michigan and northern Indiana were found to be well adapted to the crop. In this region mint culture has become highly specialized. Similar types of land are in successful use for mint in the Pacific Northwest, from which region about 15 per cent of the total production of mint oils in this country is obtained. In recent years the industry has been developed on a commercial basis in central California and eastern North Carolina.

Mint growing, if intelligently conducted, brings fair acreage returns to those who engage in it as an established farming operation. The crop is very susceptible to unfavorable weather, especially in the spring, and the yield of oil per acre therefore varies greatly from year to year. The market demand for mint oils is steadily increasing, but a sudden and considerable increase in production would no doubt have a most unfavorable effect on the industry.

This bulletin supersedes Farmers' Bulletin 694, entitled " The Cultivation of Peppermint and Spearmint."

Washington, D. C. Issued February, 1929

PEPPERMINT AND SPEARMINT AS FARM CROPS

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INTRODUCTION

COMMERCIAL MINT CULTURE was introduced into the United States more than 100 years ago, when it became established as an industry in Wayne County, N. Y. (Fig. 1.) Both peppermint and spearmint yield an essential oil which is the principal marketable product, although there is a limited use for the dried herb of peppermint. Spearmint has long been grown as a culinary herb, but its culture for this purpose is limited to the home garden. Peppermint oil, which is the most important of the mint oils, enters into numerous medicinal products, but its principal use is for flavoring candies, chewing gum, and tooth pastes. Spearmint oil is less in demand because its use is confined almost exclusively to the flavoring of chewing gum.

From New York peppermint culture extended westward, first to northern Ohio and later to southern Michigan, where the first planting was started in St. Joseph County as early as 1835. The success of this venture led to the extension of the industry in the southwestern part of the State and into the northern counties of Indiana. The large areas of muck soil in this region were found to be so well adapted to mint culture that it soon became the center of production, while in central New York the plantings were gradually diminished until at present less than 50 acres are devoted to this crop in that section. The area planted to peppermint in Michigan and Indiana is reported to have reached 40,000 acres in the last few years. Only part of this area, however, has yielded productive harvests.

The success that attended mint culture on the muck lands of the Middle West naturally led to experimental plantings in other parts of the country where areas of similar land were available. About 20 years ago it was found that the soil and climate of western Oregon were very favorable for the crop, with the result that the Pacific coast is at present the second most important production center. Reclaimed muck lands along the Willamette River in Oregon and along the Columbia River in Oregon and Washington are now devoted to this crop to the extent of about 2,000 acres. Smaller areas in southwestern Oregon and in the Yakima Valley of southern Washington bring the total area devoted to mint culture in the Pacific Northwest to about 3,000 acres. In the past few years the industry has also become established in a small way on the San Joaquin River lands in Tulare and King Counties, Calif. The reclaimed muck land in the Dismal Swamp section of eastern North Carolina has also been found suitable for mint. Although less than 100 acres are at present under cultivation in that section, it is very probable that the acreage will be gradually extended.[1]

FIG. 1.—A field of first-year peppermint in Wayne County, N. Y.

The acreage of spearmint is relatively very small. Several thousand acres are scattered throughout the Michigan-Indiana district, and small areas are under cultivation in the other regions referred to.

TYPES AND DESCRIPTION OF MINT PLANTS

Peppermint, known botanically as *Mentha piperita* (fig. 2), occurs in two commercially important forms, usually referred to as black mint and white mint. Both varieties yield the peppermint oil of commerce, but they differ somewhat in their adaptiveness to the cultural conditions found in this country. The white mint is generally considered to yield a finer oil than the black mint, but it is noticeably less hardy and on the whole is less productive than the black mint. The latter was introduced into this country from England and is the variety now almost exclusively grown in the commercial mint districts. It has dark-purple stems and deep-green, broadly-lanced leaves, slightly toothed. The white variety has green stems and light-green leaves, more pointed, and deeply toothed.

---

[1] Farmers in the principal mint-growing sections are referred to the following publications for further information:

BOUQUET, A. G. B. PEPPERMINT PRODUCTION FOR OIL. Oreg. Agr. Col. Ext. Circ. 221, 5 p. 1925. [Mimeographed.]

DUNCAN, J. R. PEPPERMINT GROWING IN MICHIGAN. Mich. Expt. Sta. Spec. Bul. 153, 11 p., illus. 1926.

WOODBURY, C. G., and SAYRE, C. B. MINT GROWING IN NORTHERN INDIANA. Ind. Agr. Expt. Sta. Circ. 65, 14 p., illus. 1917.

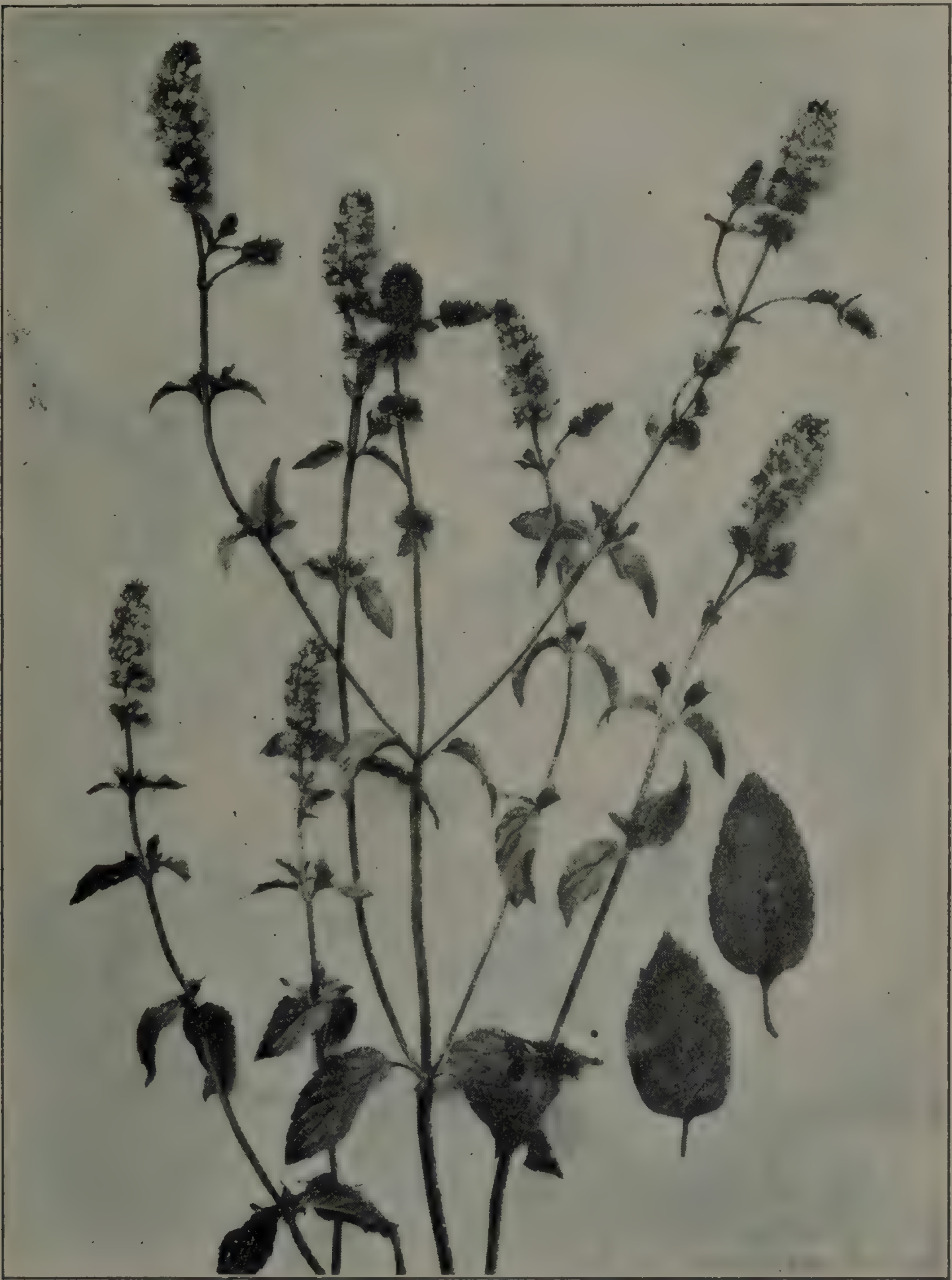

FIG. 2.—Peppermint (*Mentha piperita*) in bloom

Spearmint (*Mentha viridis*) (fig. 3) has many of the characteristics of peppermint but can readily be distinguished from it. The leaves are longer and of a lighter green color, and the flower spikes are more pointed. It has a less agreeable odor than peppermint, and the two are not readily confused by those who recognize the distinctive characters of the oils.

A number of forms of native mint occurring naturally in many parts of the United States contain oil, but it is of poor quality. These plants have no commercial value, and if mint culture is to be undertaken on land where they occur they must first be thoroughly eradicated before the commercial variety is planted, for if allowed to remain to any considerable extent they will unfavorably affect the quality of the oil obtained.

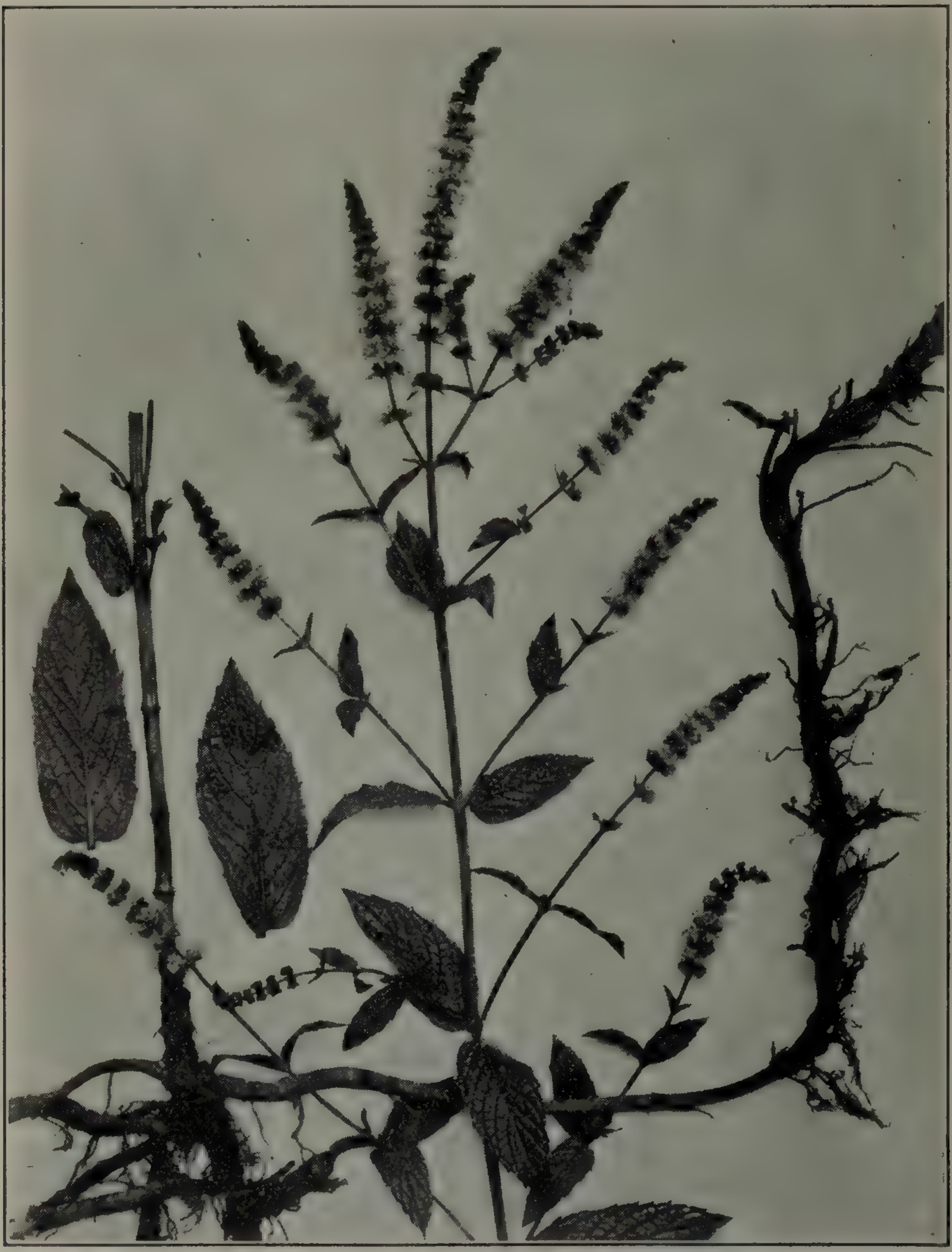

FIG. 3.—Spearmint (*Mentha viridis*) in bloom. The rootstock or runner shown is typical of the underground portion of the mints

The mints are perennial plants with square stems. They produce profuse blooms but rarely set seed. They reproduce readily, however, by means of abundant runners which spread in all directions near the surface of the ground, sending up new growth at the nodes or joints. The plants grow to a height of 3 feet, or more if the soil is rich and if they are crowded. When grown in rows or if kept sufficiently thinned out the plants develop numerous side branches and assume a bushy character. The oil occurs in numerous minute glands on the under surface of the leaves. From this it is obvious that the yield of oil depends largely on the proportion of leaf surface present. It is important, therefore, that the cultural practices employed be such that the plants may develop as much of the bushy character as possible.

CULTURAL DIRECTIONS

SOIL REQUIREMENTS

The mints prefer deep, rich soil, well drained but retentive of moisture, and of fairly open texture to permit easy root penetration. Land that contains a large proportion of clay and is so situated that drainage is slow can not be successfully used for this crop. An abundance of humus is desirable, and experience seems to have shown that a nonacid soil is necessary. These preferred conditions are most readily available in well-drained swamp lands, usually referred to as muck soils, which have been so successfully used for growing celery, onions, cabbage, and similar crops that require the quickly available soil elements necessary to produce strong and rapid growth. Upland fertile sandy or gravelly loams of good depth and proper texture that will produce potatoes and corn are also reasonably suitable for mint culture. Such soils were at one time used extensively for this purpose, especially in Wayne County, N. Y., but at the present time upland mint culture has been almost entirely abandoned in the principal mint-producing regions. The opinion prevails that on such lands the crop can not be maintained in a clean and thrifty condition as long as on muck soils.

The large level tracts of muck lands common in Michigan and Indiana are subject to severe blowing in the spring after prolonged drought, when strong winds lasting several days are not unusual. The fine particles of sand present in the muck, driven by the wind, gradually cut to pieces the tender young growth and thus cause extensive damage. In areas where the landscape is broken by occasional stands of timber the damage from blowing is much less. The use of windbreaks gives promise of reducing damage from this cause. Figure 4 shows strips of rye planted in a large field of first-year mint to serve as windbreaks. Permanent plantings of willows for this purpose have also been made.

Although the largest areas of muck lands are available in the Michigan-Indiana district, extensive tracts also occur in the Pacific Northwest. In Oregon the so-called "beaver dam" lands in the Willamette Valley are of the same general character as the midwestern muck soils, and these are coming into extensive use for mint culture, the most notable example being in the Lake Labish district. (Fig. 5.) These areas have been ditch-drained and cleared of timber and provide an unusually rich soil. Smaller areas of the same character are found in other parts of the Willamette Valley. These lands are subject to annual overflow of the Willamette River early in the spring. The water table follows the level of the river and is controlled largely by means of gates in the drainage ditches. By means of these ditches the underground water level may be raised high enough during the dry summer season to bring moisture up to the roots to the extent necessary. On the islands in the Columbia River, particularly on Puget Island, and along the mainland in the vicinity of Cathlamet and Skamokawa, Wash., are considerable areas of muck and river-bottom lands which have come into important use for mint culture. (Fig. 6.) These lands have been reclaimed by means of dikes. Another important district is the Portland flat, on the south side of the Columbia River at Portland, Oreg. Small pockets of bottom land which can be made available for the crop are to be found in many places in this general region extending from southwestern Oregon to Puget Sound.

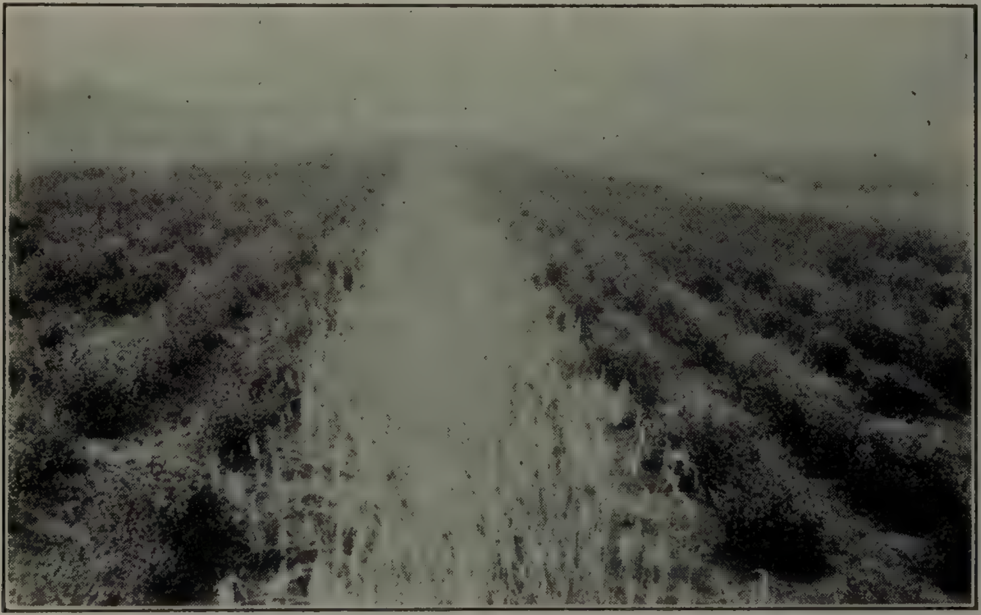

FIG. 4.—Rye grown as a windbreak in a large level field of first-year peppermint on muck soil

Next in importance as mint land in the coast district is the sandy-loam soil. This land is found at a higher elevation along the Willamette River. It also is drained by ditches or dikes and in most cases is subject to overflow in the spring. Such soil types are planted to mint in the vicinity of Eugene and Salem, Oreg., and Woodland, Wash. On the whole, this soil produces a lighter crop of mint than the muck soils already described, but with good cultural practices they have been found to be very well adapted to the crop.

Within the last few years, as a result of two seasons of abnormally high oil prices, mint farming under irrigation has been introduced in the Yakima Valley in Washington on lands heretofore largely devoted to alfalfa and fruit. Small areas have been planted in the several irrigation districts extending from Sunnyside in the south-central part of the State as far east as Kennewick. The soil in this region is mainly a sandy loam, but some plantings have been made on clay soils. Mint growing in this district has hardly passed the experimental stage, and its probable future under conditions existing there can not be predicted at this time.

PREPARATION OF THE GROUND

Land selected for mint culture should preferably be summer-fallowed for a year or planted to some crop that requires frequent and clean cultivation, in order to remove from the soil most of the weeds which cause a great deal of trouble in a mint field. The eradication of perennial grasses is especially desirable, because after the mint has spread beyond the planted rows and the ground can no longer be frequently worked with deep cultivators they are difficult to destroy or control.

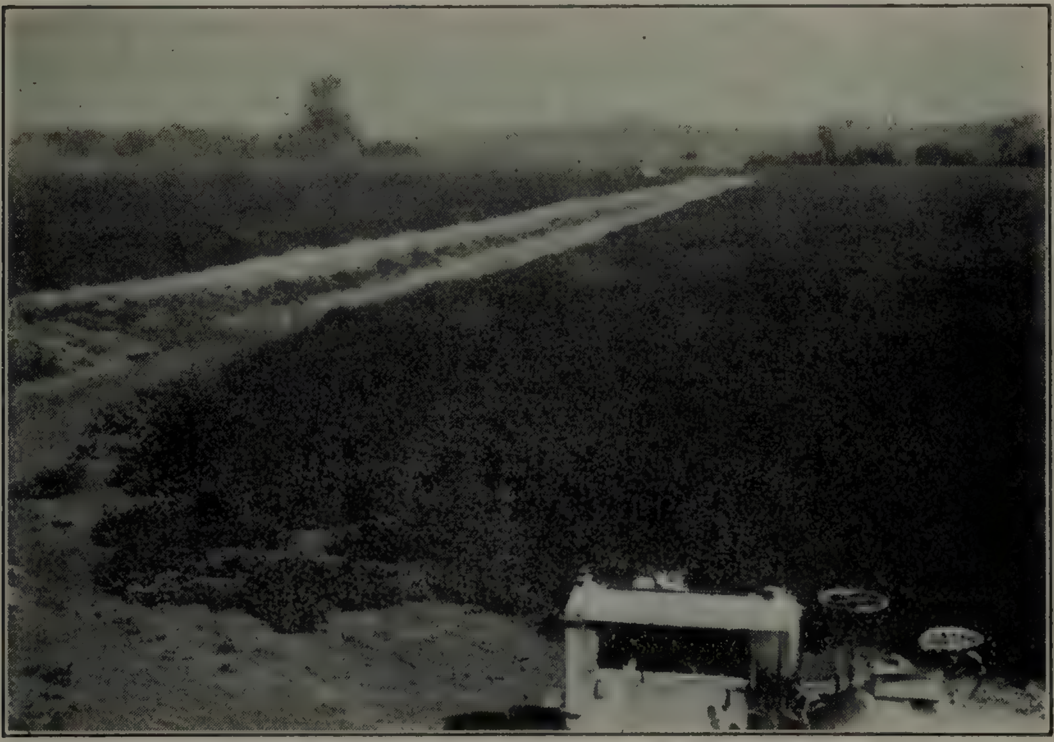

FIG. 5.—An old peppermint field in the Lake Labish district, near Salem, Oreg.

In the Middle West the muck land to be planted to mint may be plowed in either fall or spring. Fall plowing is preferred by some growers because there is then more time available, and the ground can be prepared for planting somewhat earlier in the spring. If fall plowing is not practicable the plowing should be done early in the spring or as soon as the land is dry enough to permit teams or tractors to operate. After plowing, the field is disked and thoroughly harrowed and frequently rolled in order to pack the loose soil. If the land is plowed in the fall it will be firmer in the spring, and it may be necessary to disk it in both directions in order to get it in the best condition. In the coast district fall plowing is not generally recommended for lands that are subject to overflow during the winter and early spring, because of the greater danger of the soil washing when in a loose condition.

PROPAGATION AND PLANTING

PROPAGATION BY RUNNERS

Runners for planting are obtained from a field previously selected for the purpose, usually one that had been planted during the preceding spring. In order to assure the best quality of planting stock, only a field that had produced a thrifty, vigorous stand should be set aside for this purpose. The removal of the runners from the ground is accomplished in several ways. The rows may be plowed out and the runners shaken out of the loose soil with pitchforks and deposited in convenient piles, or a potato digger may be used with a considerable saving of hand labor if the condition of the land makes the use of heavy implements possible. In the coast district runners are frequently dug from older fields in muck soil where the plants have become broadcast and the ground is crowded with runners. The field is cut with some convenient implement into blocks about 18 inches square which are then lifted with a pitchfork and the soil shaken out. The yield of runners in such cases is reported to be very large.

FIG. 6.—A field of old peppermint on Puget Island, Wash., in the Columbia River

As a rule, mint runners become established after planting with little difficulty, provided they are in good condition when planted and growing conditions are favorable. Their vitality is easily affected, however, if they are permitted to wilt through exposure to the sun or wind. The approved practice, therefore, is to cover the piles of runners with dirt or other material if they are not to be immediately planted. Planting in very dry soil is inadvisable, especially if there is no prospect of an early rain. In order to retain as much moisture as possible in the furrows these should not be laid off faster than the planting proceeds, so that the runners may be laid in the slightly damp soil. For the same reason the runners should not be left exposed in the furrows but should be immediately covered.

Planting is started as early as conditions warrant. In the West it usually begins early in March, but in the central district the muck lands are not generally in workable condition until a month or more later. The ground should be reasonably warm and not too wet. Prolonged cold and wet weather immediately after planting frequently causes the runners to rot. Late spring frosts following a period of warm growing weather which has caused the young growth to appear above ground do much damage. While the destruction of this new growth by frost does not kill the runners, it depletes their strength and frequently prevents a full crop from developing.

Immediately before planting, the field, previously prepared as described, is laid off in furrows about 3 feet apart and 4 inches deep with some suitable implement. Usually a homemade drag with proper furrowing tools attached is found to be very satisfactory. Planting is done either by hand or by machines. The hand planter carries a sack full of runners so strapped around his shoulders that the runners may be readily taken out of the opening. He drops the runners into the furrows lengthwise and generally end to end. As he moves along he pushes the dirt over them with his foot and packs it down by walking on the row. If the runners are not satisfactorily covered by this method the covering may be completed by means of a leveler or shovel plow. An experienced mint planter can plant nearly an acre a day on an average, but inexperienced help will not average more than half an acre. These estimates are based on the practice of laying the runners end to end in rows 3½ feet apart. Much depends also on the condition of the soil. Deep loose soil which makes walking laborious naturally slows up the planter. The condition of the runners used is also a factor.

In recent years machine planting has come into general use, especially on the large mint farms. A number of machines have been designed that have made it possible to plant quickly large areas for which sufficient hand labor is not always available. It is claimed also that these machines reduce the cost of planting.

The quantity of runners required to plant an acre of ground depends on the spacing of the runners in the furrows and the distance between the furrows. An acre of well-established mint, in which there has been no winter damage, will frequently yield enough runners to plant 20 acres, but on an average only enough for 10 or 15 acres are obtained. If a grower is selling runners to another grower in the same locality the usual practice is to sell a designated area in the field and let the buyer dig the runners and haul them away. If runners are sold to distant points they are usually packed in grain sacks and shipped with as little delay as possible. Even under the best conditions there is generally some loss in such planting stock, either from drying out or from decay due to too much moisture and lack of ventilation. The cost of runners depends largely on the demand. When oil prices are high there is usually a brisk demand for planting stock, which brings an increased price as a result. Seventy-five dollars is generally considered a fair price for runners from an acre if the buyer digs them himself. Assuming that the runners from 1 acre will plant 10 acres, the cost of planting stock at this rate is $7.50 an acre. Runners shipped in sacks sell for about 75 cents a sack of 2-bushel capacity, f. o. b. shipping point, under normal conditions, but much higher prices have been obtained at times. About 20 sacks are required on the average to plant an acre. Under normal circumstances new growers usually purchase only sufficient runners to plant a few acres and in subsequent years enlarge their plantings at a comparatively small cost by means of the stock thus obtained.

PROPAGATION BY YOUNG PLANTS

In the last few years considerable attention has been given to planting new fields with young plants instead of with runners. In a well-established mint field innumerable young plants that sprout from the joints or nodes of the runners will appear in the spring. When these new growths are about 4 or 5 inches high they may be readily pulled out of the ground, especially out of muck soil, with a small cluster of fibrous roots at the base of the stem. Such young plants can be successfully transplanted under reasonably favorable conditions after permanent warm weather has arrived, late in May or early in June. Machines such as are used for transplanting tomatoes, cabbages, and similar plants have been found useful for setting these young mint plants in the field. They are operated by three men, one driver and two setters. At least two men are required to pull the plants from the field, and sometimes one additional man is needed to transport them from the field to the planter. Such a crew, it is reported, can plant from 3 to 4 acres a day, setting the plants 1 foot apart in rows 3 feet apart.

The use of young plants instead of runners for starting the mint field has a number of advantages. The planting can be undertaken late enough in the spring to avoid the cold weather which so frequently retards or even destroys the fields newly planted with runners. Such fields can not always be replanted with success, with the result that in years when unfavorable spring weather prevails a considerable percentage of the acreage planted to new mint is in such poor condition that it is not harvested. It is probable, therefore, that if the practice of starting new fields with plants instead of runners is more generally adopted it may have a decided influence in minimizing the effects of unfavorable spring weather on the extent of the mint crop.

CULTIVATION

The mints require frequent cultivation to keep the ground in the most favorable condition for root penetration and to control the growth of weeds. Frequent use of fine-toothed harrows and weeders or rotary hoes (figs. 7 and 8) is recommended on both old and new fields. These implements do but little damage to mint plants 5 or 6 inches in height, and if used frequently for stirring the ground when the weeds are very small they are a very efficient means of control. In new fields cultivators are used frequently between the rows until the spread of the runners into the open spaces makes further tillage inadvisable.

Old fields are worked with spring-toothed cultivators or harrows as early in spring as possible. This loosens the soil and promotes the growth of the plants from the runners and at the same time destroys many of the weeds. If the ground is well filled with runners and new growth appears in great abundance this practice may be continued for some time, since the thinning out that results from the use of such implements is on the whole beneficial to the crop, which otherwise has a tendency to become too dense. However, cultivation in old fields can not be continued long enough to control the weeds entirely unless the field has been kept very clean in previous years. Hand weeding is therefore usually necessary, and weeding crews are sent through the fields several times during the summer to remove the weeds that are most likely to damage the oil. Nettles, mare's-tail, pigweed, and smartweed are common and very objectionable. Some weeds color the mint oil, while those which in themselves contain oil with a pronounced odor are particularly to be avoided. Various grasses frequently cause considerable trouble. Although these may not unfavorably affect the oil to the same extent as the weeds mentioned, they are difficult to eradicate, since most of them are perennials and spread rapidly by means of their rootstocks under the conditions usually found in the older mint fields. In some localities the fields must be abandoned after two or three years on account of such grasses, which, as a rule, are a more serious problem on upland than on the looser muck soil.

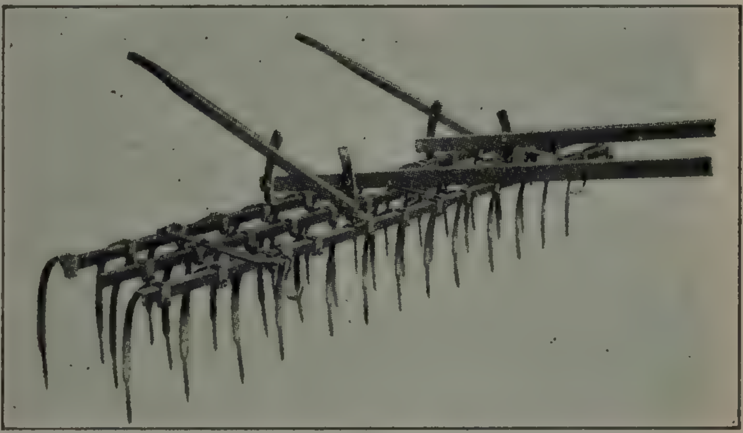
FIG. 7.—A fine-toothed harrow used in mint fields to control weeds

After the mint crop has been removed the fields receive no further attention until late in the fall. In the central and eastern districts they are plowed before the first heavy frost is likely to occur. Earlier plowing may be followed by warm weather and is therefore not advisable, since in order to avoid winter damage the runners should remain entirely dormant after they have been turned under. Fall plowing is especially desirable because the runners are comparatively close to the surface and are subject to much winter damage if not plowed under 4 or 5 inches. In the case of spearmint the fields frequently are not plowed until spring, since the runners of this mint are deeper in the ground. In the coast district fall plowing is recommended only on land that does not wash during the heavy winter rains or the spring overflow. If fall plowing is satisfactory this should be done as late as possible, but before the advent of the heavy rains, which rapidly make the land too soft for plowing.

In subsequent years the cultural requirements are the same as in the second year. On rich soil the stand frequently becomes too thick unless winter damage occurs, and in such cases more frequent use of cultivators is advisable in order to thin the stand. Weeds and grasses become more numerous, and the gradual depletion of necessary soil elements results eventually in smaller returns. When this condition is reached it is best to plow out the mint and plant the land to other crops for several years. Upland soils will not usually maintain a profitable mint crop for more than three years, largely because of the difficulty of controlling weeds and grasses. Muck soils with their greater natural fertility and with the loose texture that permits more efficient control of the weeds have occasionally been cropped continuously to mint for six or seven years without being replanted.

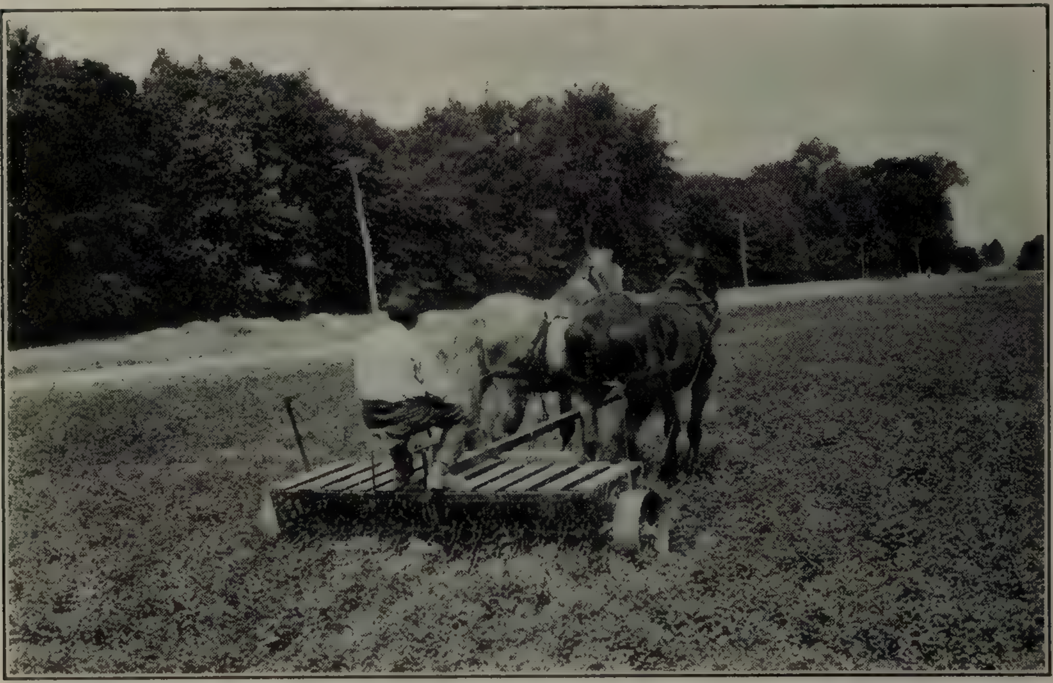

FIG. 8.—A rotary hoe in use on an old mint field early in the summer

FERTILIZERS

The fertilizer requirements of the mints are not well understood and have not been the subject of systematic investigations. Observations by successful growers, however, indicate that the crop is noticeably benefited by a judicious application of commercial fertilizers in accordance with the special requirements of the land used. It has already been stated that the crop is best adapted to nonacid soils; hence the application of several tons of a neutralizing material such as ground limestone is necessary if acid soils are used. A deficiency of potash in the muck soils has frequently been observed, which has led to the practice of applying from 100 to 200 pounds of the sulphate or muriate of potash to the acre. Regarding the use of phosphoric acid there is less agreement among the growers, but a reasonable application to land that is distinctly deficient in this respect is no doubt of value. Most of the newly reclaimed swamp lands that are coming into general use for mint culture in the coast district contain sufficient nitrogenous material resulting from decomposition of the large quantity of vegetative matter present to furnish the quickly available elements needed for rapid and vigorous growth. On similar soils that have been cropped for longer periods, as is the case in the central district and on upland soils, the mint crop is much benefited in the early part of the season by the application of 100 to 150 pounds of nitrate of soda to the acre. The use of barnyard manure for this purpose has not been found advisable, because it introduces a great many weed seeds unless it has been very thoroughly rotted. However, the liberal use of manure in the preceding year when the land is planted to a crop that permits frequent cultivation and a thorough destruction of weeds is of great benefit. The return of the spent mint herb from the still to the field as a source of nitrogenous fertilizer is generally considered to be good practice.

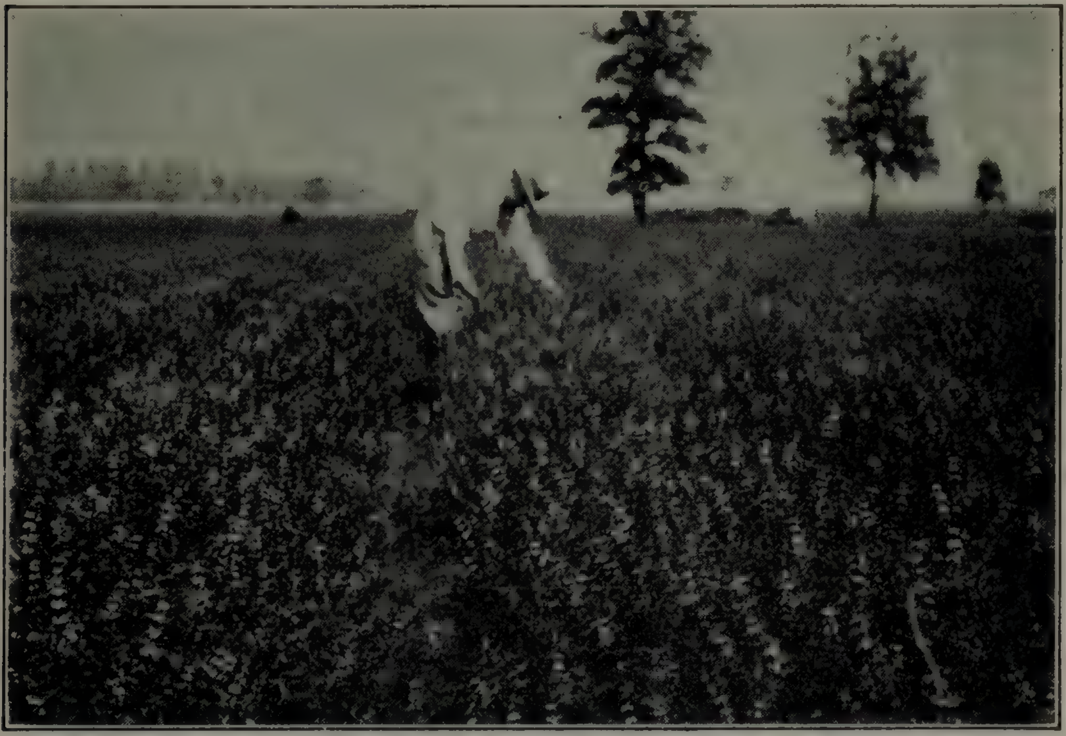

FIG. 9.—A fine stand of first-year spearmint in Michigan ready for harvesting. This field, photographed about September 1, was damaged by frost about a month previously, but made a good recovery

HARVESTING

Both peppermint and spearmint contain the maximum amount of oil when the plants are in bloom, and so far as possible the harvesting should take place at this stage. (Fig. 9.) The flowers on the individual plants do not all open at the same time; therefore the period of blooming is relatively long. When large acreages are to be harvested it is best to start when the early flowers are in bloom, unless the distilling equipment is ample to handle the entire crop in a very short time. In this way when the last part of the crop is cut the plants will not have passed considerably beyond the main blooming stage. The oil content diminishes rapidly as the foliage begins to fall with the passing of the flowering period, and the loss of oil resulting from a harvest too long delayed is greater than that resulting if the crop is cut somewhat early. New mint reaches the proper harvesting stage several weeks later than old mint, which makes it possible for the grower to harvest his old fields before the new ones are ready.

In eastern North Carolina harvest begins early in July. In California also most of the crop is ready in this month, while in Oregon and Washington harvesting generally takes place from the 1st to the 15th of August. The later arrival of spring weather in the central district makes the harvest period there extend through August and sometimes well into September. In all these districts, however, unusual weather conditions in some years advance or delay the harvest several weeks. In the coast district two harvests are frequently obtained. In California especially, this practice is general, since the longer growing season and the late arrival of fall rains are favorable conditions for this purpose. In Oregon and Washington, on the other hand, it is generally necessary to cut the first crop rather earlier than usual if it is desired to bring a second growth to reasonable maturity before heavy rains reduce the yield of oil and seriously interfere with the proper curing of the herb in the field. Early harvesting is also sometimes necessary on the fertile muck soils when the stand is very thick and rank. Under such conditions a considerable loss of leaves occurs before the blooming period is reached, and to avoid this it is better to cut the crop early. On such fields there is a good opportunity to develop a reasonably productive second crop. The oil obtained from immature herb is frequently of inferior quality and is lacking in those characteristics that the market demands. The two-crop practice therefore is of doubtful value even if the yield of oil is larger, unless the seasonal conditions make it possible to cut both crops in a reasonably mature condition.

Harvesting is accomplished by both hand and machine methods, according as conditions make one or the other the more practicable. New mint in rows is very frequently cut with scythes, especially if the rows are somewhat ridged. Even on some of the largest mint farms this method of harvesting new mint is preferred. A large crew of men is put into the field, each man following a row, cutting first from one side and then returning along the same row and cutting from the other side. The row is thus cut close to the ground and no herb is wasted. Mowing machines have been adapted for cutting new mint with a minimum loss of herb. Several large guards attached to the sickle bar lift the lower branches from the ground and thus prevent the tops from being cut off and lost. Older mint that has spread all over the field is harvested with mowers drawn by either horses or tractors, the latter being especially equipped for the purpose with a sickle bar operated by direct drive. (Fig. 10.)

After the mint is cut it is allowed to lie in the swath for a day or longer until it is partially dried, when it is raked into windrows with a side-delivery rake. If the weather is fair and drying proceeds rapidly it may be hauled from the windrows to the still. In dull weather it is frequently necessary to place the herb in small cocks like hay, to continue the curing. (Fig. 11.) Some growers prefer this method as a regular practice, while others find it more economical to load directly from the windrow with hay loaders. Complete drying so that the herb is brittle is carefully avoided, because in such condition it can not be handled without the loss of foliage and a resulting loss of oil.

For hauling the herb the ordinary flat hay racks have been found very serviceable. Onto these the material can be loaded with the least labor and a minimum of shattering. On one of the largest mint farms in the country the herb is loaded and firmly packed directly into large metal forms hauled on low-bodied wagons. On arrival at the still the entire load is lifted out of the form by means of lifting chains attached to a sling, which is laid on the bottom of the form before it is loaded. The crane swings the load directly over a distilling tub,[2] into which it is then dropped. The forms are a trifle larger than the tubs and slightly wider at the top than at the bottom, which permits the load taken from it to fit snugly into the tub and to fill it completely. By this method the time required for unloading and charging a tub is greatly reduced. It has the further advantage that loss of oil due to handling the herb with pitchforks or hayforks is avoided. The general practice, however, is to transfer the herb to the tub by means of pitchforks or to use some form of hayfork operated by a team of horses or by a crane and windlass. In some of the newer distilling plants steam-hoisting cranes are in successful use.

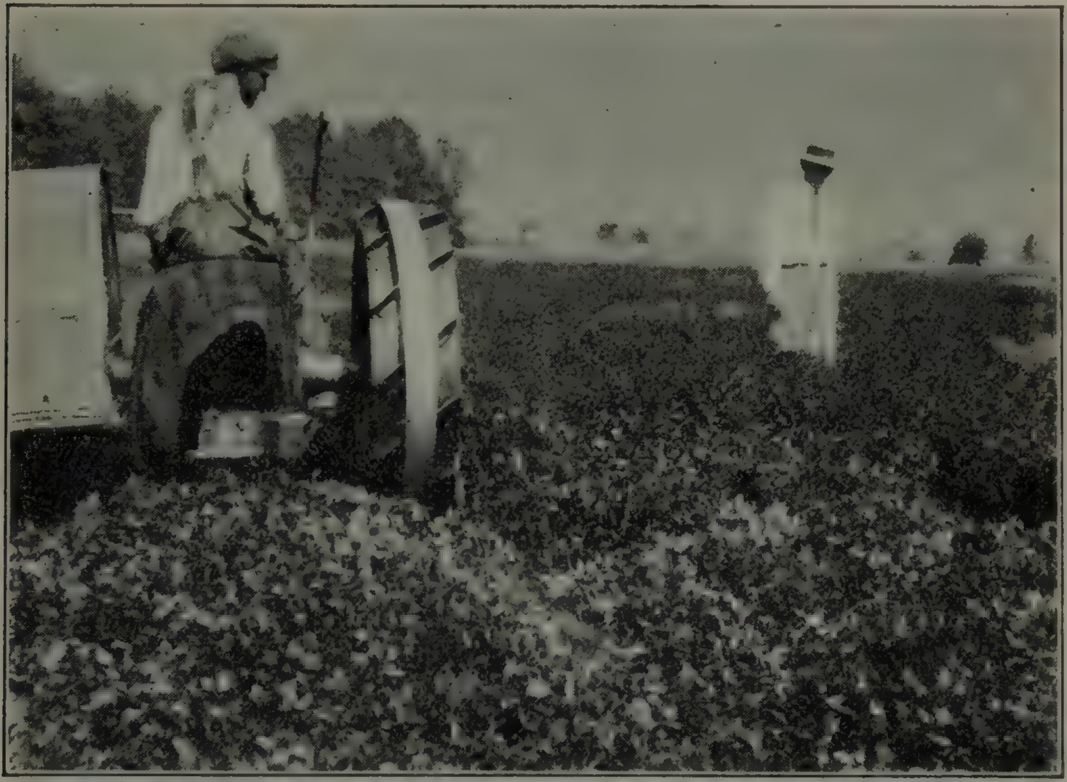

FIG. 10.—Harvesting spearmint with a tractor mower in Michigan

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[2] Several terms, such as "tub," "vat," and "retort," are commonly used to designate that part of the distilling equipment in which the herb is packed.

DISTILLATION OF THE OIL

The process employed for removing the oil from mint is very simple. It consists of passing a current of steam through the herb, whereby the oil is vaporized and the steam and oil vapors are conducted through a worm or other form of condenser where they are condensed to water and oil. The water and oil are collected in suitable receivers, in which they separate into layers, the oil floating on the surface of the water. Although the equipment used for this purpose has been gradually improved, the method of operation has on the whole remained unchanged.

DESCRIPTION OF STILLS

A distilling equipment consists of a boiler for generating steam, a tub, a condenser, and a receiver. The general arrangement of these several parts may vary according to conditions, but the whole equipment should be so assembled that the outfit may be installed at the lowest cost and operated with the greatest saving of labor. Even the smallest distilling units include two tubs operated with one condenser, so that one may be charged while the other is being distilled. On the larger farms one usually finds four tubs operated in pairs with a condenser for each pair. (Fig. 12.) These tubs are set down part way in a wooden platform which serves as a working floor, the tubs projecting usually about 2 feet above this floor. A lifting crane with windlass is mounted between the two tubs of a single unit, or in the center of the platform in the case of a two-unit outfit, so that it may be used for loading and discharging each tub.

FIG. 11.—A mint-harvesting scene in Michigan

The tubs in use vary somewhat in size, but are generally designed to hold one load of herb. They are 6 to 9 feet in height and diameter, most of them measuring 7 feet in both directions. Some are of slightly larger diameter at the top than at the bottom, to facilitate the removal of the spent herb. In the early years of the industry they were constructed entirely of wooden staves, and many such are still being built, but the tendency at present is to construct them of heavy galvanized steel. The wooden tubs are built like stave vats or cisterns, held together with adjustable iron rings. In the top edge is a groove about half an inch wide in which is set a strip of heavy felt or some other suitable material which projects slightly above the edge. The cover of the tub, which is constructed of narrow wooden planks properly reinforced with crosspieces, rests on this strip, which permits it to be clamped down, thus making it steam tight. The clamps, consisting of threaded iron rods fitted with turn bars, are hinged to the side of the tub a short distance below the cover so that they can be swung up over the edge of the cover through slots and screwed down. The steam is admitted from a 1½-inch pipe just above the bottom. An even distribution of steam through the charge is effected by means of a cross T with open ends. The steam outlet is through a pipe from the side just below the cover. This pipe has a diameter several times as large as the inlet pipe, in order to prevent pressure from building up in the tub. It usually extends upward and then passes overhead to the condenser.

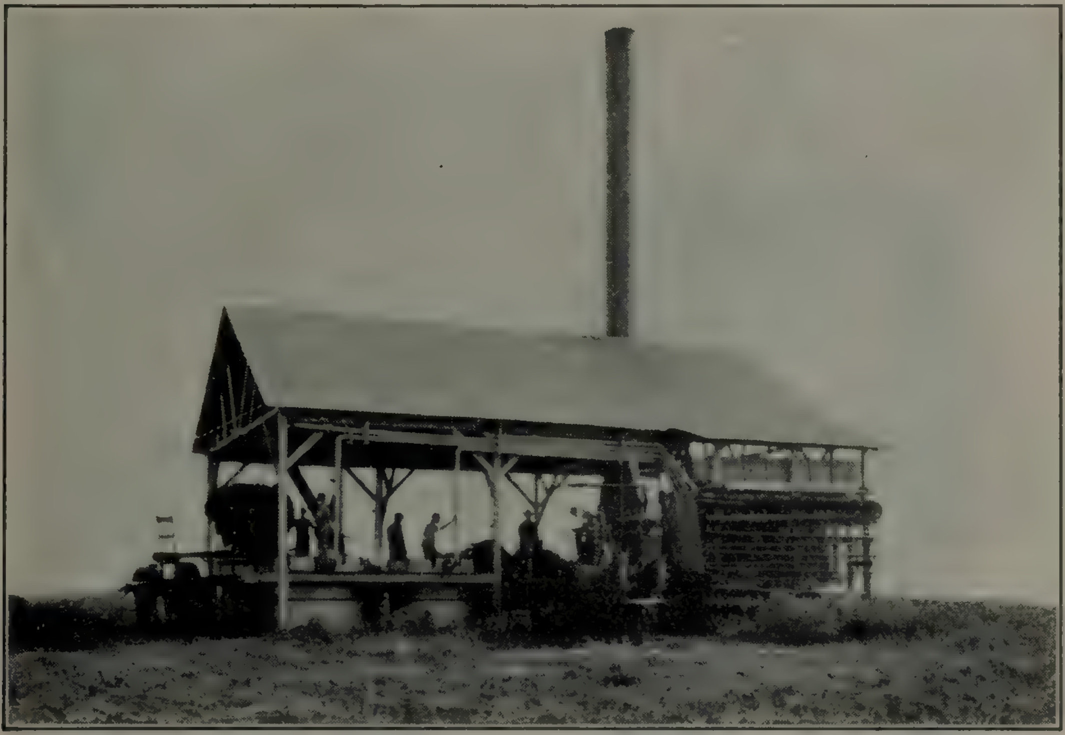

FIG. 12.—A four-tub mint still with worm condenser

The metal tubs now generally being installed are constructed of No. 16 gauge galvanized steel. (Fig. 13.) The steam-tight gasket consists of a flat strip of composition material riveted to the rim of the tub or to the under edge of the cover. The cover is fastened down by means of adjustable eccentric clamps.

The condenser in common use, especially among the smaller growers, sometimes referred to as a worm condenser, consists of six or eight horizontal sheet-metal pipes joined at the ends by elbows to form a continuous series. (Fig. 14.) The first two lengths of pipe from the top are 7 or 8 inches in diameter, and the remainder are reduced successively in size, the last one, from which the condensed oil and water flows, being 2 or 2½ inches in diameter. Condensation is obtained by water flowing over the pipe from a perforated trough mounted directly above the condenser. This water drains into a lead-off trough mounted below the third or fourth pipe, and a second perforated trough immediately below it furnishes a fresh supply of cold water for the remainder of the pipes. The water flows to the troughs by gravity from a reservoir overhead. A steady and ample supply of water is drawn by pumps either from wells or from small streams in the vicinity of the stills. The hot water which drips from the condenser is frequently used in the boiler, with a considerable saving of fuel. At some convenient point in the upper part of the condenser is an air vent which can be opened to admit air when the steam is shut off. This will prevent the condenser from collapsing, which otherwise is likely to occur because air can not enter fast enough through the small end of the condenser. The type of condenser described has come into extensive use mainly because it can be constructed at a small cost, but it is soon destroyed by rust. If built of copper pipe lined with tin it will last many years.

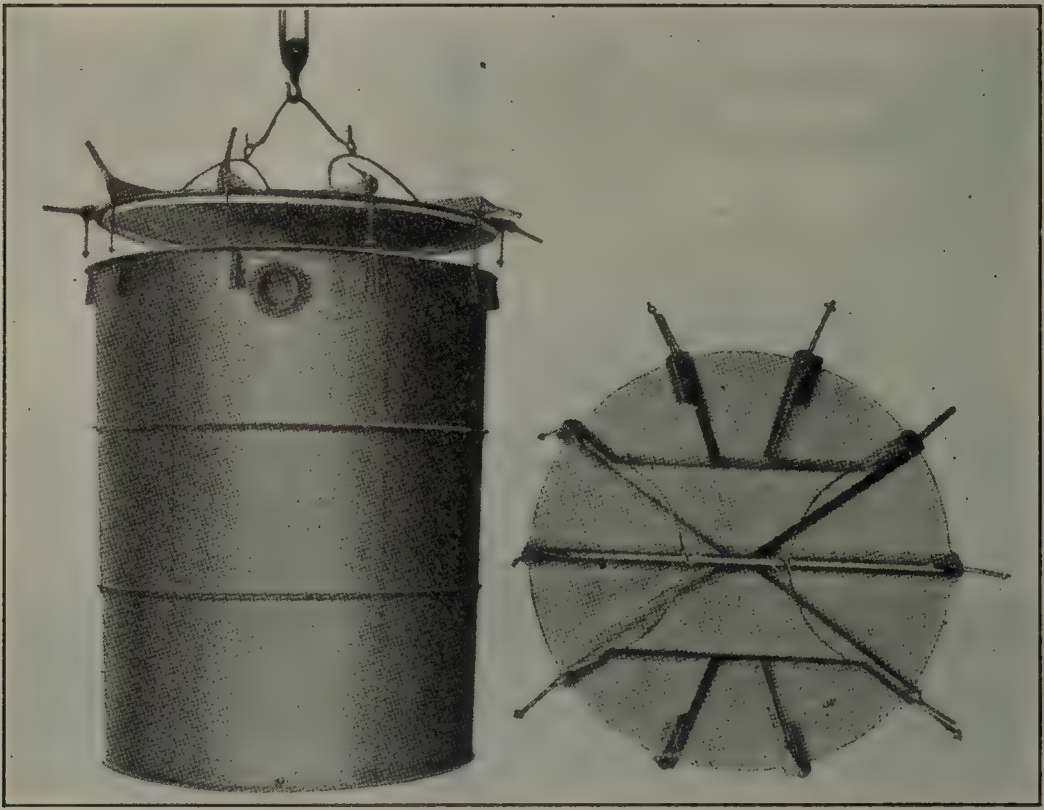

FIG. 13.—A type of galvanized-steel mint tub in common use

On the Pacific coast an equipment differing in some details from that described has long been in use. It consists of two metal tubs, each of which is fitted with an open collar around the rim about 5 inches wide and 10 inches deep. This collar is filled with water. The cover has a turned-down edge which fits into the collar, thus making a water seal. The vapors leave the retort through a gooseneck from the center of the cover and are conducted to a worm condenser. The union of the exit pipe and condenser is also sealed with water by means of a similar arrangement. When the charge in the tub is exhausted the cover is lifted by means of a hoist and swung over for use with the other tub. With this type of equipment no clamps are required, but steam pressure must not be allowed to develop in the tub or the cover will be forced up and the seal broken.

A tubular condenser has lately come into use, which consists of an upright galvanized-steel shell in which are mounted numerous upright galvanized-iron pipes of small diameter, somewhat like the flues in a boiler. (Fig. 15.) As the steam and oil vapors pass down through the pipes from the top they are condensed by the cold water which circulates around the pipes, and the resulting water and oil flow from a narrow outlet into the receiver. Such a condenser is rather expensive, but it lasts a long time, requires but little space, and is very efficient. Figure 16 shows a modern still equipped with tubular condensers.

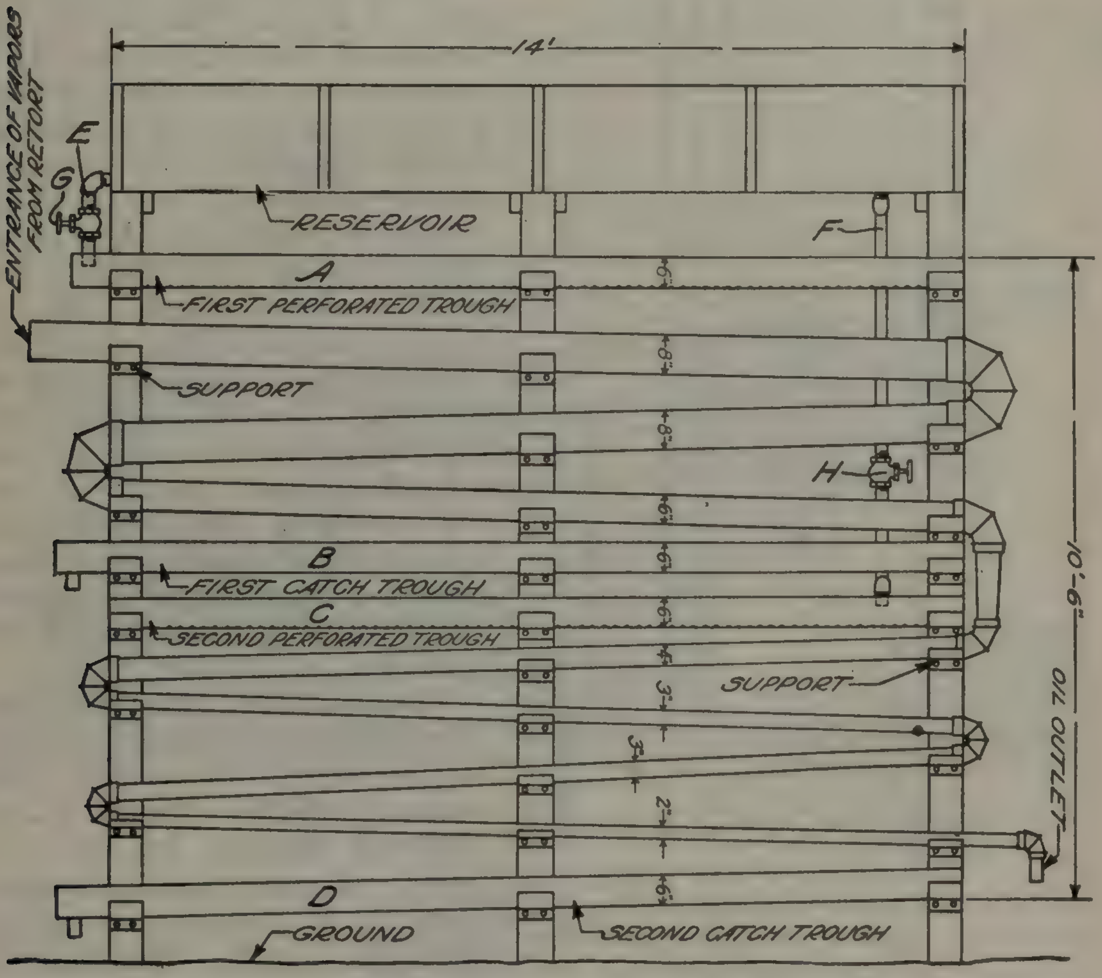

FIG. 14.—Details of a large single-unit worm condenser

The receivers in which the oil is collected are of simple design and construction, varying from 10 to 50 gallons in capacity. They are made of galvanized iron and are cylindrical in shape. Since the oil floats on the water, the latter is drawn off the bottom as fast as it enters by means of a pipe which extends up along the side of the receiver to a few inches from the top, where it is fitted with an elbow or gooseneck. As the distillation proceeds the surface of

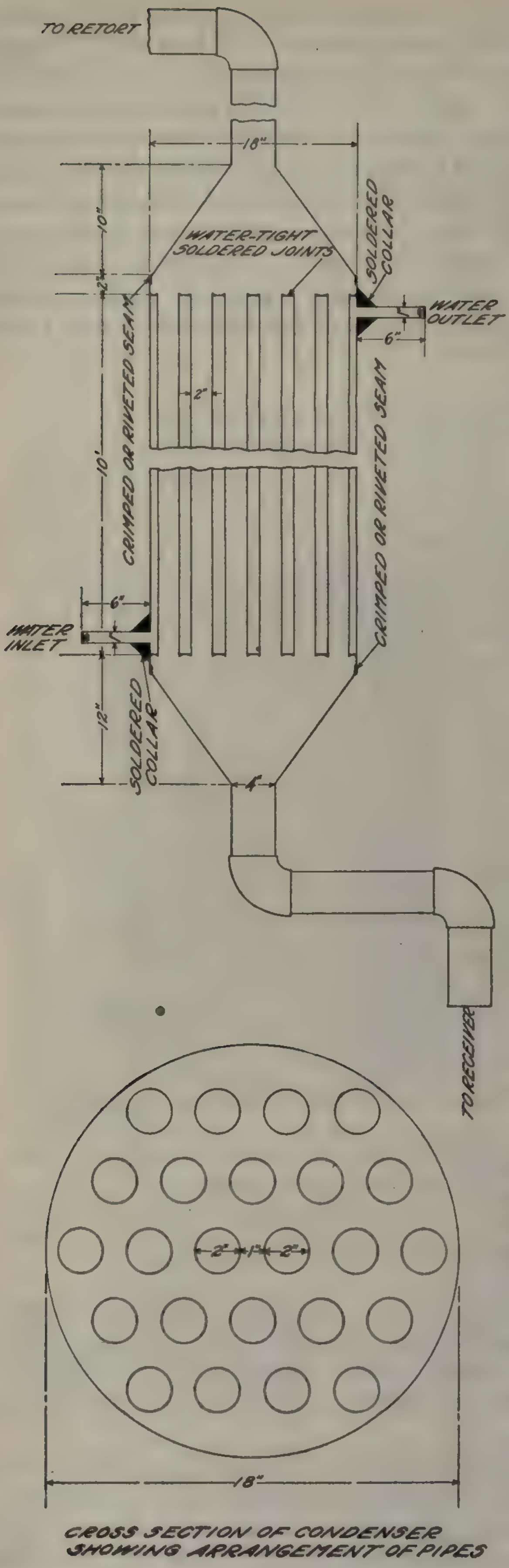

FIG. 15.—Details of a tubular condenser

the oil in the receiver is maintained at the same level as in the gooseneck from which the water drains. At a point about one-third the distance from the top of the receiver is an outlet with a stopcock from which the oil may be drawn off. A number of devices are used to prevent churning of the contents of the receiver by the flow from the condenser, since this might cause some of the oil to be drawn off with the water. One method is to direct the flow into a pipe with a funnel top which extends two-thirds the distance to the bottom of the receiver, where it is fitted with a short return elbow that directs the oil toward the surface. The receivers shown in Figure 17 are of this type. Another plan is to admit the stream from the condenser into the receiver at a point about two-thirds the way down by means of a pipe, a baffle plate immediately below the inlet directing the separated drops of oil upward toward the surface.

The efficiency of a distilling plant depends largely on an ample supply of steam. The boiler therefore should be of sufficient capacity for all purposes. In most cases it is operated at a steam pressure of about 85 pounds. The boiler is the most expensive unit in the distilling equipment, but a reconditioned boiler can usually be obtained at a considerable saving.

OPERATION OF STILLS

When a tub is charged, the herb is packed down thoroughly so that the steam will pass uniformly through the charge instead of channeling, as is likely to be the case if the material is loosely or unevenly packed. An iron ring or a crosspiece with chains attached is placed on the bottom, and when the tub is half full the chains are laid across the charge and the steam partly turned on. A second ring is then introduced and the loading completed. By means of these rings and chains and a crane the spent herb can be readily removed from the tub in two batches. The slow admission of the steam while the loading is in progress makes it possible to pack the herb much more firmly. After the cover has been thoroughly clamped down, more steam is turned on, and when the condensed vapors of steam and oil begin to flow from the condenser the admission of steam is so adjusted that condensation is complete, with no loss of oil vapors.

The time required to exhaust a charge depends on the quantity of steam admitted and the condition of the herb. The drier the herb, the shorter the time required. Steam coming in contact with green herb is partly condensed, and a much longer time is therefore required to complete the operation. In most cases, if the herb has been well cured, the steaming is continued for about 45 minutes or an hour. This period is sufficient to permit the second tub to be emptied and reloaded.

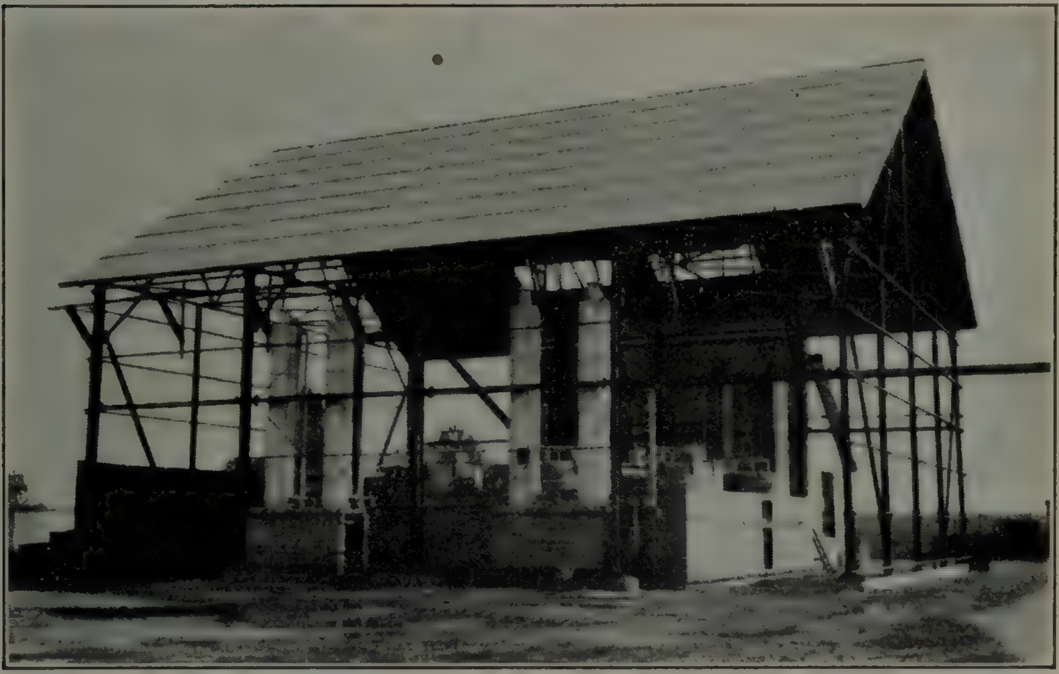

FIG. 16.—A partially completed mint still of modern design. Eight tubs are arranged in a circle, each one connected with a multitubular condenser

The exhausted material is deposited on wagons or trucks by means of the crane and hauled away. If spread out on the field and properly dried it makes excellent fodder, and its use for this purpose is a common practice. It is relished by all kinds of stock and in feeding value is reported to be equal to timothy hay. It is also used to advantage as a fertilizer, and when intended for this purpose is spread on the field and plowed under in the fall. Some of the large growers at times deposit the refuse on large dumps, where it is allowed to decompose before being spread on the field.

The oil as it is removed from the receiver is stored in tin cans, usually of 5 or 10 gallons capacity, or where the distillation is conducted on a large scale it is placed in heavy drums holding 40 or 50 gallons. As a rule the oil separates readily from the water and if carefully removed is entirely clear. Some growers prefer to filter it before storing, but this is not usually necessary. Rectification by a second distillation is not generally necessary unless the oil is highly colored or of unusual composition. Under normal conditions if the fields have been kept free from weeds and distillation has been carefully conducted the oil obtained is entirely acceptable to the trade, and rectification, as a rule, will not sufficiently increase its market value to compensate for the cost of the treatment and the loss of oil resulting therefrom. The process can not generally be undertaken to advantage by the average grower, although it is frequently employed by the large producers.

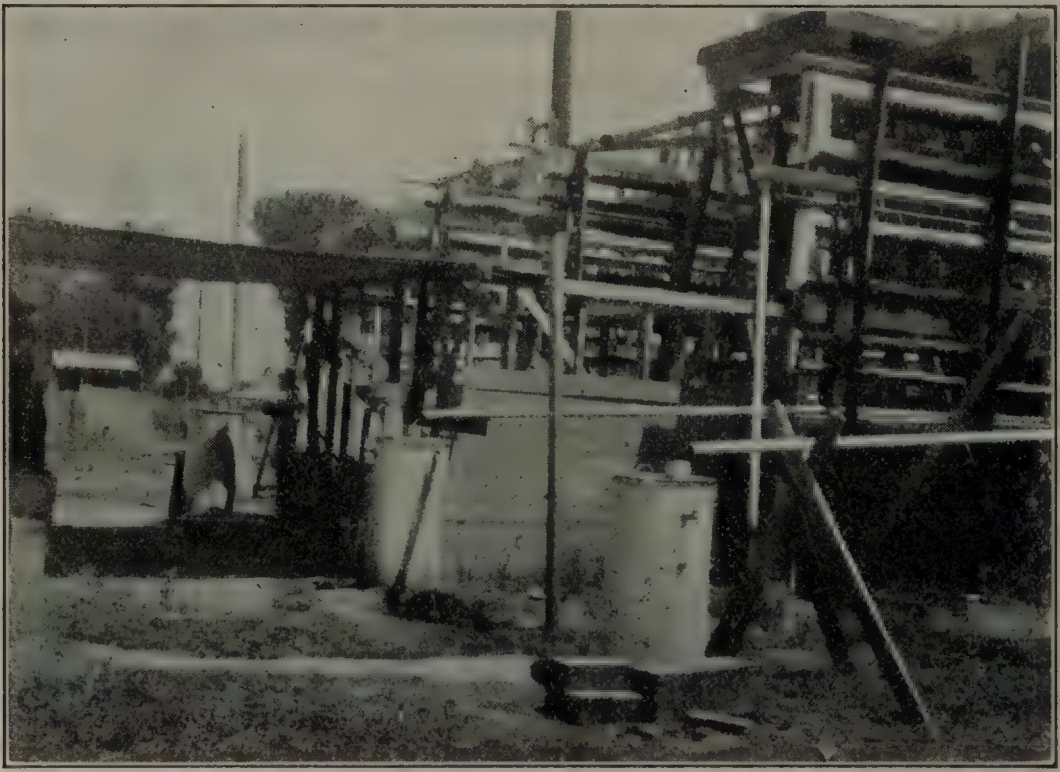

FIG. 17.—A view of the worm condensers and oil receivers of a mint still in California

Both peppermint and spearmint oils may be kept for an indefinite period without material change in quality if stored in a cool place in clean tin cans or in drums completely filled to exclude the air.

YIELD OF OIL

The yield of oil from the mints varies greatly according to seasonal conditions, the character of the crop, and the geographic location. In Michigan and Indiana 30 pounds of oil per acre is considered a fair average on well-managed farms. In seasons of unfavorable weather this average is greatly reduced, but, on the other hand, yields considerably in excess of this figure are frequently obtained from good fields when rainfall and temperature are normal. New mint usually yields somewhat more oil than old mint, and on muck lands the crop is generally more productive than on upland. In Oregon and Washington the yields are higher, 80 and 90 pounds per acre being occasionally reported from the muck-land districts. The average on such lands is estimated at 50 to 55 pounds to the acre. In California, where the crop is cut twice, the seasonal average is still higher.

The largest yield of oil is obtained if the herb is harvested in the full-blooming stage. If the plants are too thick in the field to permit full leaf development, or if many of the lower leaves fall off on account of continued dampness due to the thick stand, the yield of oil is greatly reduced. Clear, sunny weather during the few weeks immediately preceding the harvest causes the herb to develop more oil than if cloudy, wet weather prevails. Heavy rains at harvest time wash off considerable oil, and rough and excessive handling of the herb if it has been permitted to become too dry also causes loss due to shattering of the leaves. Under similar cultural conditions peppermint and spearmint yield about the same quantity of oil per acre.

DISEASES AND PESTS

The mints are subject to few serious diseases. The most important of these is a rust fungus which frequently does severe damage by causing the loss of foliage during wet seasons. There are no practical control measures for this fungus, and the only way to avoid a total loss in fields heavily infested is to cut the crop before the disease is too far advanced. Lack of proper soil and moisture sometimes causes a chlorotic condition, evidenced by a yellowing of the leaves, which drop off in large numbers, but losses from this trouble are not general.

A serious insect pest, the mint flea beetle (*Longitarsus menthaphagus* Gentner) has in recent years caused much concern in the central region, according to the Bureau of Entomology. In the adult form this insect feeds on the foliage, its presence being usually first observed by the numerous small holes that appear in the leaves. The damage from this, although considerable at times, is of less importance than that caused by the larvae. In the late summer the beetle lays its eggs in the soil, and from these the larvae are hatched the next spring and enter into the main roots and underground stems of the mint plant, where they feed on the inside tissues, thereby causing the plant to wilt and die. In a field where these beetles are very numerous the crop will be largely destroyed by the larvae the following year if no control measures are undertaken. Dusting the fields with poison after the crop is removed and before the beetles have laid their eggs has given good results. Poison mixtures consisting of arsenicals mixed with talc, hydrated lime, or flour may be applied with large dusting machines, which can dust about 40 acres a day. The cost of this treatment is very low, and the control of the pest obtained thereby justifies its extensive use in beetle-infested districts. New mint subject to damage by the insects migrating from neighboring fields can be successfully protected by means of these poison dusts. Heavy damage by this insect at the present time is by no means general, but its rapid spread in the Michigan-Indiana section is feared.[3]

Cutworms sometimes do much damage in the spring if the weather is wet and cold. Grasshoppers also are destructive in some seasons. Both of these pests can be controlled by means of poisoned bait.[4]

PRODUCTION COSTS

The cost of producing mint oil is variously estimated. The cost of preparing the ground, planting, cultivating, and harvesting is about $75 an acre, exclusive of fertilizers, taxes, and rental value of the land. Distilling costs are estimated at about 30 cents a pound of oil if the herb is of average quality. After the first year the cost is considerably less. In the Pacific coast district the establishment of a mint farm on new land is expensive if the entire cost of clearing the land is charged against it. However, since oil yields are generally higher than in the central region, the cost of production per pound is probably about the same. The class of labor available and the cost of hand weeding necessary are important factors. In New York State the growers are required to pay higher wages than in Michigan and Indiana, and consequently their production costs are considerably higher. On the whole it seems to be the general opinion that under present conditions mint oils can not be produced at less than $2.50 a pound on the average farm where both old and new mint are under cultivation.

A still, consisting of two metal tubs with a worm-type condenser and loading equipment but exclusive of the boiler, can be built for about $400. A new boiler of sufficient capacity costs about $1,000, but reconditioned boilers are usually available at a much smaller cost. A modern equipment, including four metal tubs, two of the best type condensers, oil receivers, horizontal bricked-in reconditioned boiler, secondhand hoisting engine, and loading platform, all housed in a well-constructed building, was recently built in Indiana for $4,000.

The grower who has less than 20 acres of mint under cultivation finds it more economical to haul his crop to a still in the neighborhood, if one is available, and pay the usual charge for such service, which varies from 30 to 50 cents a pound of oil. In localities where mint culture is a new undertaking a number of growers can advantageously equip and operate a still cooperatively until the acreage has been enlarged sufficiently to warrant individual equipment.

PRODUCTION AND CONSUMPTION OF MINT OILS

The United States is the principal producing country of peppermint and spearmint oils. England, Germany, France, and Italy produce relatively small quantities. Japan has under cultivation a vast acreage of a different species of mint which yields an oil of different quality used largely as a source of natural menthol, of which it contains a high percentage.[5] Accurate statistics on the world's production of mint oils are not available. In this country the production averages about half a million pounds. In 1926 and 1927 the producton of peppermint oil reached approximately 700,000 pounds, but in the two years immediately preceding the crop was considerably below the average. The production of spearmint oil averages about 50,000 pounds. The use of peppermint oil in the manufacture of several widely used products that are in increasing demand assures a steady market. Considerable quantities of American oil are exported to other countries where the production is not sufficient to meet requirements.

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[3] Information on the mint flea beetle and the methods of controlling it are contained in the following bulletin: GENTNER, L. G. THE MINT FLEA-BEETLE. Mich. Agr. Expt. Sta. Spec. Bul. 155, 13 p., illus. 1926.

[4] WALTON, W. R. GRASSHOPPER CONTROL IN RELATION TO CEREAL AND FORAGE CROPS. U. S. Dept. Agr. Farmers' Bul. 747, 18 p., illus. 1922. (Revised ed.)

——— CUTWORMS AND THEIR CONTROL IN CORN AND OTHER CEREAL CROPS. U. S. Dept. Agr. Farmers' Bul. 739, 8 p., illus. 1922. (Revised ed.)

Over a long period of years the average price received for the oil by peppermint growers has been less than $3 a pound. The trend in the price of spearmint oil has generally followed that of peppermint oil, largely because the production of both is similarly influenced by seasonal conditions. Unusual conditions sometimes result in much higher prices for these oils, but such prices can not safely be used in estimating the returns which may be expected from mint growing. The industry is especially subject to wide fluctuations in market conditions, and a period of attractive prices is likely to be followed by a sufficient extension of the acreage to cause overproduction.

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[5] Japanese mint is grown to a very limited extent in the United States. Outside of scattered small acreages in North Carolina and Michigan, the only planting in this country is in central California, where there are approximately 400 acres. Information regarding the culture of this species of mint may be obtained from the Office of Drug, Poisonous, and Oil Plants, Bureau of Plant Industry, U. S. Department of Agriculture. The law does not permit the use of the term "peppermint" in the labeling of goods flavored with Japanese mint.

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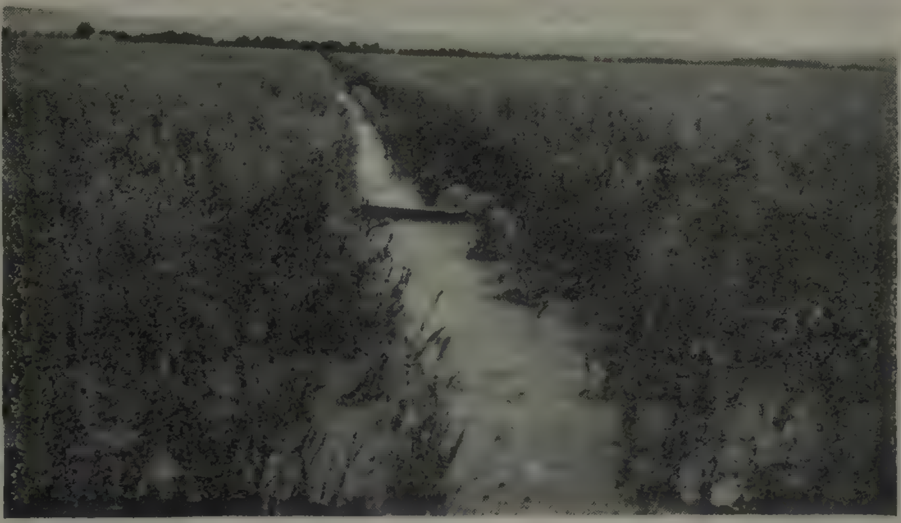
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1556

Rev. May 1940

IRRIGATION of SMALL GRAIN



GRAIN IS GROWN on irrigated farms, as a rule, only in localities having short growing seasons, on new land, or where grain is included in a system of rotation.

Methods of irrigating grain are restricted somewhat because the crop covers the entire ground surface. Objections to the flooding method—based on the loss of water by evaporation—have less weight in the irrigation of grain than in the case of most other crops, since water seldom is applied until the crop is high enough to protect the soil surface from sun and wind.

Grain is usually the first crop grown on new land, and on such land flooding generally gives better results than do other methods. Flooding from field ditches is the usual method employed, but wild flooding, the border method, and the corrugation method also are adapted to such crops. These methods are discussed in this bulletin, as are also the preparation of the land for irrigation, the proper time to apply water, and the quantity of water required.

This bulletin is a revision of and supersedes Farmers' Bulletin 863, entitled " Irrigation of Grain."

Washington, D. C. Issued June, 1928

IRRIGATION OF SMALL GRAIN

By W. W. McLaughlin, *Associate Chief, Division of Agricultural Engineering, Bureau of Public Roads*

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INTRODUCTION

AS A RULE grain is the first crop grown on newly cultivated land, but few irrigated farms can be made to pay if permanently devoted to it. Hence in well-established irrigated sections, grain is grown only as a secondary crop in a rotation, or to utilize land with water supplies insufficient to mature more remunerative crops.

The yields of irrigated grains are considerably higher than those obtained by dry-farming methods, but a yield of even 40 or 50 bushels of wheat per acre is not enough to warrant its continued production under irrigation where more valuable crops can be grown.

This bulletin is concerned primarily with the irrigation of small grain (wheat, oats, and barley) on new land.

PREPARING THE LAND FOR IRRIGATION

The settler on a new farm is likely to be too busy erecting his buildings and clearing and planting his land to devote enough attention to the proper preparation of the land for irrigation. Therefore he obtains better returns the first year from grain, corn, and potatoes than from other crops. These crops mature with limited moisture and thrive exceptionally well on new land.

Before permanent crops, such as alfalfa, are planted, the field should be leveled carefully and irrigated. Usually, if the crop is alfalfa, there is not time to do this and then relevel the field before planting must be done; but grain may be seeded and irrigated through the season, during which time the farmer may determine where the surface needs further dressing off or filling in. This releveling can best be done after the grain has been removed but before the land has been replowed, the water marks serving as guides in filling depressions or in leveling down knolls.

It is common practice, where the growing of winter grain is possible, to follow this final leveling with the seeding of fall grain as a nurse crop for alfalfa. If the planting is done early enough in the season alfalfa is seeded at the same time; otherwise it is seeded the following spring. This practice leaves the ground in good condition for the irrigation of all later crops.

ADAPTABILITY OF WINTER GRAIN

In recent years winter wheat has taken the place of spring wheat to a considerable extent in portions of the arid region. This is because it has been found, quite contrary to ideas prevailing even 10 years ago, that winter wheat will stand extremely low temperatures without winter killing, when the seed bed is suitable for germination and the crop is sown early enough for the plants to reach the stooling stage before freezing weather stops their growth. Furthermore, irrigation water can be used to far better advantage on winter grains than on spring grains. In many localities winter precipitation is insufficient to furnish the moisture essential to germination and to carry the crop to the stooling stage. It is therefore necessary to apply water to the land either before or very soon after seeding in order that germination may be complete and the crop given the proper start.

When irrigated during the very early stages of growth, grain is likely to be injured by the operation, or at least retarded in growth, as compared with the crop grown in a seed bed which contains sufficient moisture to keep it growing without irrigation until a later stage of development.

Winter grain, if it reaches the stooling stage before freezing stops its growth, is in condition to grow rapidly as soon as spring weather comes. Where fall and winter precipitation has been light, spring irrigation is required to produce a full crop. In that case the water may be applied during the early season when it is most plentiful. Usually the crop is matured early in the summer before the period of low-water supply has advanced very far. Spring grain will require at least one more irrigation than is necessary for winter grain because of the difference in development at the beginning of the spring growing season, and because of the corresponding difference in maturity. This is especially true if spring grain is seeded on spring-plowed land.

IRRIGATION AND THE SEED BED

The most vital operation in the season's work in producing a crop of grain is the preparation of the seed bed and the most important consideration in establishing a proper seed bed is that of providing an adequate moisture supply. It is essential to the production of a maximum crop that the seed bed contain sufficient moisture to carry the crop at least to the stooling stage without further irrigation. This applies particularly to spring grain and in a more general way to winter grain. The mistake of "irrigating the crop up" is made all too frequently in districts where irrigation for germination is necessary.

The importance of irrigation in preparing the seed bed must not be minimized. This is true for grain generally, but particularly for spring grain, and especially where the soil is inclined to bake. Where the soil is dry at plowing time it is desirable to irrigate before plowing. In the fall it will hardly be necessary to irrigate after plowing, but in spring it frequently happens that in the process of plowing the soil is dried out to such an extent that irrigation is necessary either before or after seeding in order to secure satisfactory germination. In either case if irrigation is necessary for germination it is better to apply the water before seeding rather than afterwards.

In the process of irrigating a freshly plowed seed bed the soil is compacted, and if inclined to bake it may become rather hard before drying sufficiently to permit seeding. Sometimes the farmer makes the mistake of using a disk on such a soil to prepare it for seeding. He should bear in mind that the surface soil will dry out as deep as it has been stirred. Therefore disking may result in drying the soil so deep as to prevent uniform germination. It is better to follow the irrigation with a spring-tooth or a spike-tooth harrow in order to break the crust and pulverize the surface soil fine enough to permit seeding. In this way the seed may be placed well into the moist soil and uniform germination will follow.

One further precaution should be taken with reference to early irrigation. It is essential that the subsoil as well as the surface soil be moist at seeding time. Frequently it will be found by digging into the soil that it is dry a short distance beneath the surface. If this be the case, the soil is in no condition to start and continue the growth of a maximum crop. The needed moisture must be added, especially before spring seeding. In fact, this is the most necessary irrigation of the season. A soil containing a full supply of moisture at seeding time, whether it be fall or spring, stands a much better chance of producing a full crop than does a soil that has barely enough moisture for germination.

METHODS OF APPLYING WATER

Three principal methods are in common use in the irrigation of grain: (1) The furrow or corrugation method, (2) wild flooding, (3) flooding from field laterals either with or without the aid of borders. The first two methods are in common use on new land and on old land that has not been prepared for a better system of application. Other modified methods may be used to advantage under certain conditions, but where such conditions exist the irrigator does not need the assistance which this bulletin is intended to render.

These methods of irrigation require field laterals and distributing ditches, and the most essential features of these will be described.

FIELD LATERALS AND DISTRIBUTING DITCHES

In the following discussion, farm laterals are the branches of the irrigation system which lead from the main supply ditch or lateral to the head ditch, the latter being the main ditch across the upper end of each subdivision of the farm. Field laterals carry water from the main head ditch to distributing ditches within the farm subdivision. A cross ditch is a ditch which leads the water across the field and distributes it to the corrugations or to the outlets from which the land is flooded.

Field laterals parallel each other and of necessity run down the steepest slopes. For this reason it is necessary to install drops, or to line the ditch, where the slope is such as to cause the stream to wash or erode the soil. Such improvements may be installed in advance, but as a rule the necessity for them is demonstrated by experience.

Head ditches run across the upper ends of the fields or subdivisions of the farm and generally at right angles to the farm laterals. Field laterals and head ditches may be made permanent and may be controlled by permanent gates at the main junction points.

To aid in distributing the water through the openings in the lower bank, cross ditches should be given just enough fall to cause a flow of water. If the slope is uniformly in one direction the cross ditches will be parallel with each other, and practically parallel with the head ditch. These ditches serve to collect the surface run-off from the section of the field next above them for reuse on the section below.

To prevent a waste of water from deep percolation it is sometimes desirable to space the cross ditches rather close together, the actual distance depending upon the nature of the soil and the subsoil. The usual tendency is to space them too far apart. The proper distance is between 200 and 600 feet, but usually not over 300 feet.

METHOD OF CONSTRUCTING FIELD DITCHES

Ordinarily field laterals and head ditches may be successfully constructed by plowing several furrows with a moldboard plow. Beginning at the inside of what is to be the permanent bank and continuing until the last two plowings are up and down the center of the ditch the dirt should always be turned out. A V crowder or a ditcher of some standard make may then be used to remove the loose dirt from the middle and crowd it out to form the bank. If the ditch must be large, several plowings and crowdings will be required, and it may even be found necessary to use a fresno or some other type of scraper to finish the ditch. On smooth ground, however, one complete operation with plow and ditcher usually is sufficient.

A good type of homemade ditcher is shown in Figure 1. More elaborate tools are available, such as double moldboard ditchers with wings attached and various patented steel ditchers. Field laterals and cross ditches usually are only temporary and are plowed or disked in before harvest. Figure 2 shows an excellent implement for this purpose.

METHODS OF DISTRIBUTING FROM FIELD DITCHES

The labor involved in the first irrigation of new land may be lightened by mapping out and constructing the type of distributing system best suited to conditions, and especially by providing in advance for the regulation of the stream. The experienced irrigator observes in advance where trouble may develop and works ahead of the stream, on dry soil, as the water proceeds down the corrugations or over the surface. This prevents injury to the crop if the seeding has been done.

THE CORRUGATION METHOD[1]

The best method to effect uniform distribution from field ditches to new land, and a method which is very satisfactory under any condition, is known as the corrugation method illustrated in Figure 3. The field is laid off in a succession of shallow furrows or corrugations which run up and down the steepest slope and guide the water in such a way as to irrigate the entire field. The cross ditches are made by plowing in one direction thus throwing the dirt downhill, away from the head ditch. This makes a small bank through which water is distributed to the land below.

The openings from the head ditch are made through firm portions of the bank, and as nearly as possible at the same level with the cross ditch below. If the head ditch runs down a heavy slope it should be built in sections, with permanent drops, so that the water may be held level in a section while distribution is being made. This aids materially in effecting a uniform distribution.

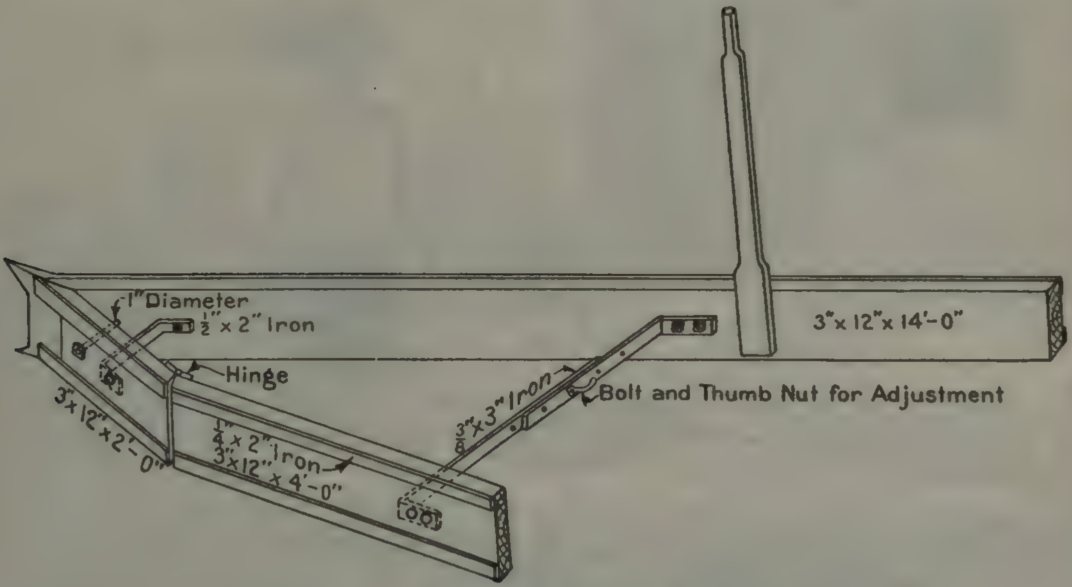

FIG. 1.—Adjustable V scraper or crowder

This method saves much hand labor in flooding uneven surfaces. It is easy to reach the high spots, prevents waste of water in low places, and where corrugations are properly located the danger of breaking from one corrugation to another is small. It is next to impossible to succeed with corrugation irrigation when the direction of flow is diagonally across a steep slope, unless the corrugations are made very deep and regular. Even then there is constant danger of a furrow becoming clogged and precipitating its water into the next one, resulting in a combined stream too large for one furrow, which then breaks into the third, and so on until the combined flow runs wild down the slope cutting gullies through the field and destroying the crop.

Several corrugations are usually supplied from one opening in the ditch bank (fig. 3) which should be made in the thickest part of the bank to prevent washing. To save labor and water, the irrigator should make all these openings and provide for distributing the stream as uniformly as possible before the water is admitted to the ditch. In addition, it is well to distribute partly rotted straw or coarse manure in piles along the ditch bank at frequent intervals to aid in controlling the water and prevent washing. If the land is new the harrowing done to prepare the seed bed probably will accumulate roots of sage brush or other rubbish, which can be left at convenient places along the head of the land for later use in controlling the water distribution. Such material aids greatly in effecting a uniform distribution to corrugations during the first irrigation. When the water has been once distributed evenly and the openings to furrows are once set, conditions should not be disturbed during the season. The shutting off of streams will be confined to the intake of cross ditches or to the main openings from such ditches to the subdivisions leading to corrugations, and it should never be necessary to close the openings to individual corrugations once the flow of water to them has been regulated.

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[1] More detailed information regarding this method is given in MARR, J. C. THE CORRUGATION METHOD OF IRRIGATION. U. S. Dept. Agr. Farmers' Bul. 1348, 24 pp., illus. 1923.

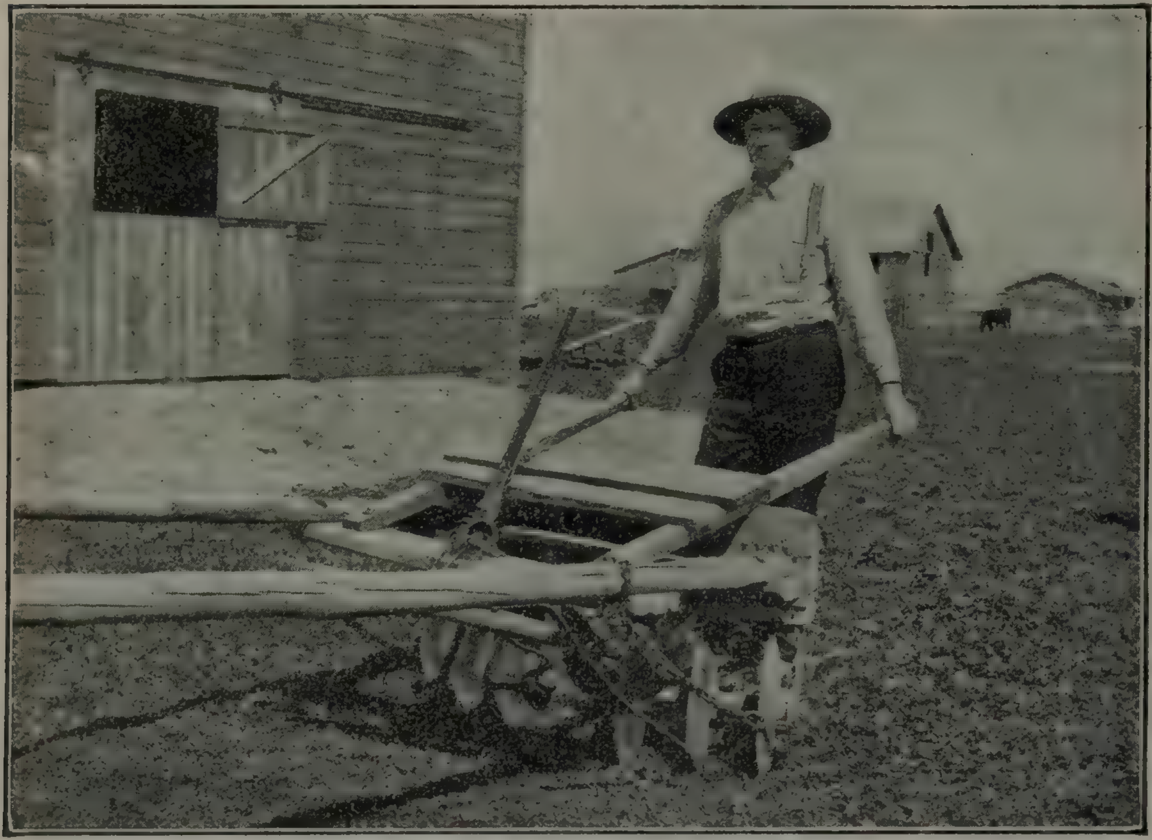

FIG. 2.—Disks set for turning in field ditches

In cases where corrugations take water directly from the head ditch or cross ditch the irrigator is likely to find that he destroys more crop in tramping back and forth and in shoveling dirt into the openings to close them off than he would have done by making an extra cross ditch just below the head ditch or regulating ditches directly below the cross ditches, as shown in Figure 3. In making such a layout as the one indicated a moldboard plow is run across the land and back, the backfurrow making a good bank below the cross ditch and leaving a regulating ditch below the bank, which needs little further preparation to make it ready for the first irrigation.

WILD FLOODING

In some localities wild flooding, or flooding from cross ditches, is practiced, but this method can not be expected to succeed on new land unless the field is level enough for large heads of water to be used to cover the high points or where, if the slope is steep, the soil is of such a nature as to resist washing.

In either case water will collect rapidly in the depressions, and where the fall is considerable there will be a tendency to uneven irrigation and to erosion. On sloping fields the cross ditches for collecting and redistributing the water must be very close together if the surface is to be covered. As irrigators become experienced wild flooding is abandoned for one or another of the better methods of irrigation.

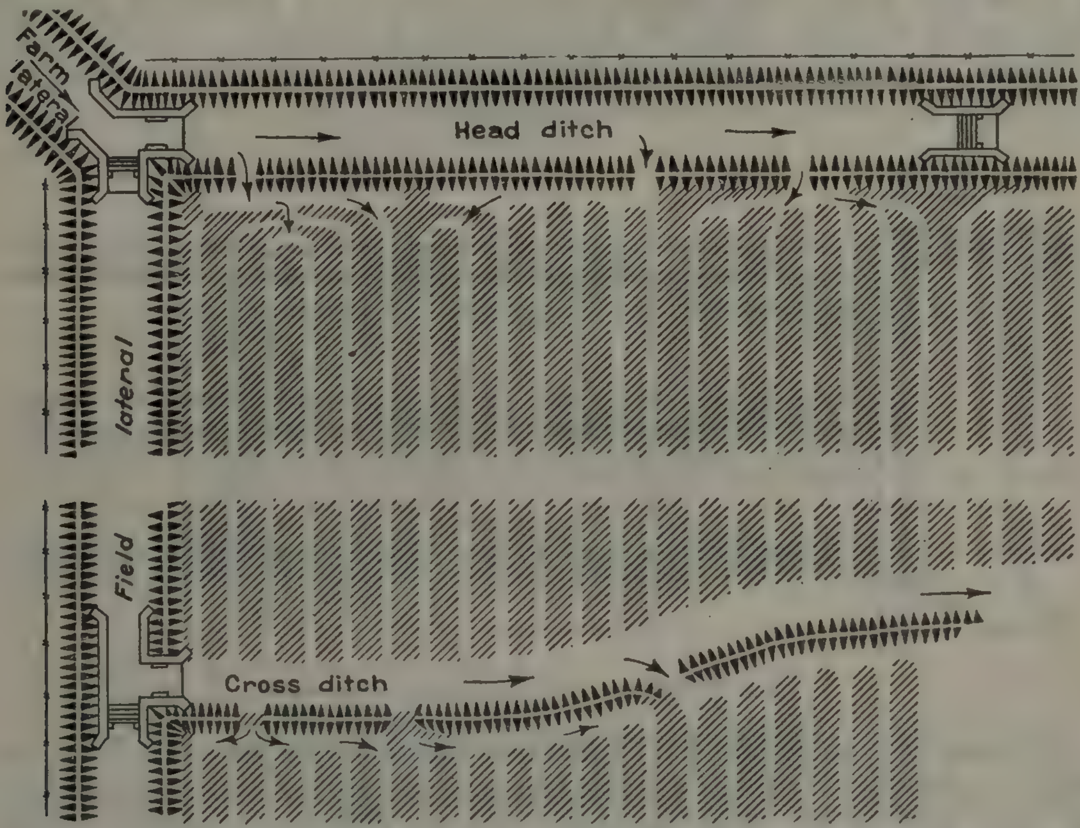

Fig. 3.—Corrugation method of irrigation, showing details of distribution. The white space across the middle of the field indicates that a portion of the drawing is omitted

FLOODING FROM FIELD LATERALS

A system more desirable than wild flooding may be provided by placing the field laterals, leading from a common head ditch, fairly close together, as shown in Figure 4. In this system the laterals run down the steepest slope, dividing the land into parallel strips varying in width from 50 to 250 feet, depending upon the topography of the surface. Water is diverted from these laterals, first at the top of the strip, then at intervals, down the slope, depending upon the character of both the soil and the surface as the watering proceeds.

These field laterals may be made more or less permanent if each strip of land is leveled by itself without regard to the strips on each side, thus providing for a uniform irrigation, which for some lands is superior to any other method. This system of irrigation is best adapted to steep slopes and porous soil.

THE BORDER METHOD[2]

Flooding between borders differs in two respects from flooding from field laterals, as may be seen by comparing Figures 4 and 5. In the first place, levees take the place of field laterals and run in the same direction; second, the water is distributed entirely from head ditches if the strips between borders are short, or from both head ditches and cross ditches if the strips are long, as indicated in Figure 5. The border method is suited to a wide variety of soils and conditions. When lands are properly leveled crosswise between borders, this is probably the best method to use in irrigating grain or any other crop which will stand flooding.

If the surface is flat and the soil porous, a large head can be used to force the water over the plot quickly and thus provide a uniform application without excessive loss by deep percolation. If the soil is compact, a smaller stream should be used for a longer period of time in order to moisten the subsoil properly.

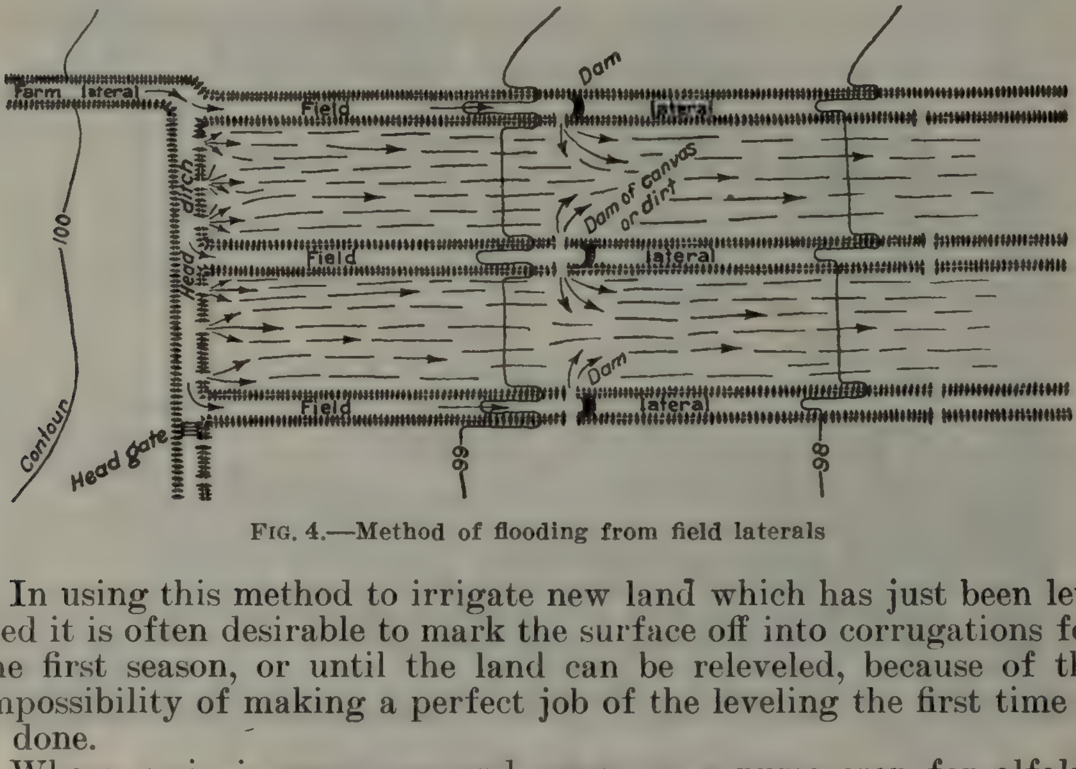

FIG. 4.—Method of flooding from field laterals

In using this method to irrigate new land which has just been leveled it is often desirable to mark the surface off into corrugations for the first season, or until the land can be releveled, because of the impossibility of making a perfect job of the leveling the first time it is done.

Where grain is sown a second season as a nurse crop for alfalfa it is usually desirable to corrugate the land between border levees in order to obtain a thorough moistening of the seed bed and give the young alfalfa a good start and a uniform stand. These corrugations usually become filled in after the first season in alfalfa.

WHEN TO IRRIGATE

The character of the soil and subsoil determines, to a considerable extent, the proper time to irrigate. A heavy soil with tight subsoil will receive and hold large quantities of moisture, making it possible to irrigate copiously and at long intervals. If a heavy soil is underlain with gravel the water will drain out and more frequent irrigations will be necessary. The same principle holds true with lighter soils; the lighter the soil and the more open the subsoil, the more frequently will irrigation be necessary, because the water-holding capacity of the light soils is less than that of the heavy soils.

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[2] Additional information regarding this method is contained in FORTIER, S. THE BORDER METHOD OF IRRIGATION. U. S. Dept. Agr. Farmers' Bul. 1243, 41 pp., illus. 1922.

In localities having a small winter precipitation, or where the evaporation is high during the winter months, as is the case along part of the Pacific coast, in New Mexico, Arizona, southern and eastern Utah, and many other localities, the advantage of irrigating during the nongrowing season has been demonstrated. Where the water supply is deficient, irrigation at any time when the water can be obtained—either in fall, winter, or spring before seeding—is of service in storing moisture in the soil for use in producing the crop. Winter irrigation is not as well understood nor are its benefits as much appreciated as would be the case were the practice more extensive. Irrigation prior to seeding is of great service in localities where the water supply is required by other and more profitable crops later in the season. In the practice of winter irrigation enough water should be applied to saturate the soil to its full depth.

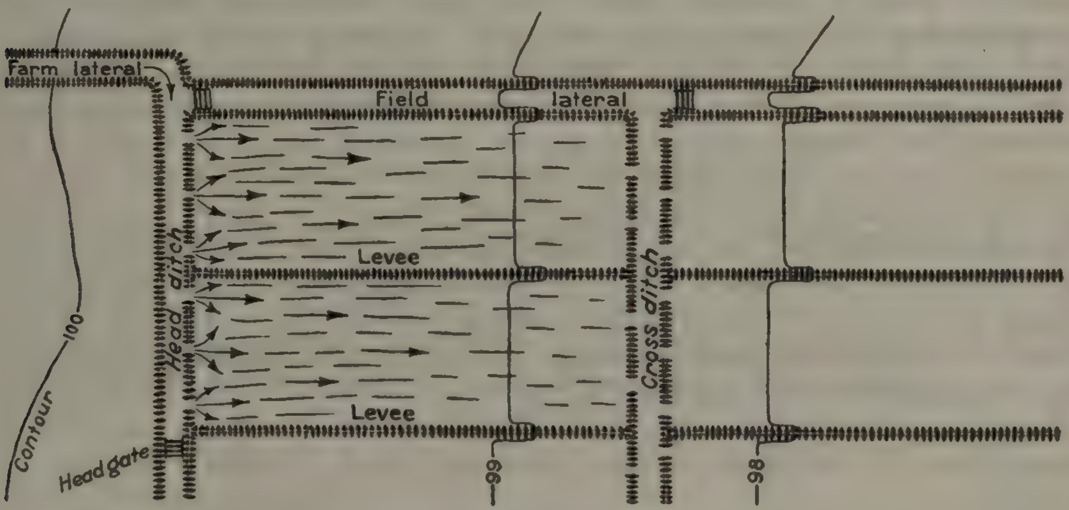

FIG. 5.—Flooding between border levees

Some difficulty is experienced as a result of irrigating heavy lands in the spring prior to seeding, as the soil dries out very slowly after irrigation and seeding is delayed. In such cases it is best to irrigate the land in the fall if winter precipitation is light. When heavy soils must be seeded in spring, and are too dry to permit germination, then it is desirable to irrigate after rather than before seeding. In this case the corrugation method of application is to be preferred. A second irrigation may then be required before the plants are large enough to shade the ground, in order to prevent damage from the hard crust which forms after irrigation. If the land is not to be irrigated until after the grain is seeded, and has not been plowed in the fall, it should be plowed, double disked, harrowed, floated, seeded, and corrugated, the operations being performed in the order named. In case the ground is cloddy, the roller or a clod masher may be used either before or after the disk.

Late summer or early fall irrigation is a very effective aid in destroying weeds on foul land. When an early maturing crop like grain is grown the land is irrigated immediately after the crop is harvested to supply moisture with which to germinate weed or other seeds in the soil and to prepare the land for plowing. It is plowed later in the fall and the weeds are turned under. The plowing is followed by disking and by another irrigation, if needed. This method of weed control is to be commended, as it not only rids the land of weeds but also utilizes much green manure.

It is desirable, for several reasons, in growing a crop for grain rather than for hay that the straw be short and not too rank; the ranker the straw the greater the danger of lodging, of rust, and other diseases, and usually the softer and poorer the grain is in quality. The growth of straw may be controlled to a certain extent by holding off the water during the early growth. Excessive irrigation tends to increase the proportion of starch, and this lowers the flour value of the grain. Holding off the early irrigation tends to hasten maturity, which is an advantage where the growing season is short. Grain sometimes starts a second growth if the first irrigation is delayed too long, which reduces the yield. The plant obtains from the soil a great part of its total weight during early growth. While the intermediate growth is taking place the plant undergoes certain changes preparatory to building up the seed. During the later growth the seed is made chiefly from material stored in the plant. More moisture is required during the early and later growth than during the intermediate stage, and it is better to let the grain suffer a little during the early growth rather than in the late stage, if water can not be depended upon at both times. Moisture must be present to transport carbohydrate and other material from the leaves and stem to the kernels or they will be shrunken, and the taller the plant the more water will be required. Lack of moisture in the early stages means a short straw, while lack of moisture in the later growth means shrunken grain. It is almost always a good rule to apply some water when the grain is in early milk to effect the transportation of food materials. Irrigation in the final stage of ripening is not good practice.

Many natural and artificial conditions influence the time and amount of irrigation, and the farmer who best understands and makes use of them is most successful. The condition of the soil and the appearance of the plant together afford a practical index of its requirement for water. An experienced farmer does not irrigate loams until a sample taken a few inches below the surface and squeezed in the hand appears barely to hold together.

The appearance of the plant is an excellent indication of the moisture condition where no considerable quantity of alkali is present. The appearance of grain when troubled in the early stages with alkali is somewhat similar to that produced by lack of moisture. Grain which has plenty of moisture is bright green in color; when it begins to suffer for water it turns a dull green, and the lower leaves begin to fire or turn yellow. When these signs are in evidence the crop needs water. It is best to anticipate the appearance of distress a little, as the grain does not show its lack of moisture until some vitality has been lost.

If the first irrigation, or the second in case it was necessary to irrigate to start the seed, is applied when the grain is in early boot, another watering should be given when it is in the late flower, and a last irrigation when it is in the late milk or early dough stage. Four irrigations seldom are required if the first occurs when the grain is in the boot, except in the localities subject to hot winds and excessive evaporation or where the subsoil is porous. Much depends upon the depth and retentiveness of the soil, but if the grain does not require irrigation until it is in late flower it probably will be irrigated again only once—when in medium milk. Better results usually will follow three irrigations than two, even though no more water is needed for the larger number of irrigations. The time of application has as much influence as the number of irrigations upon the yield and quality of grain, and frequently more.

The late irrigation of rank grain makes it likely to lodge. The water softens the stalk at or near the surface of the ground, the plant is top-heavy, and a moderate or hard wind will topple it over. This is a serious danger in windy localities, and the last irrigation should not occur too late in the grain's growth. Dampness throughout the period or too frequent irrigation tends to promote rust.

In growing grain for hay, more irrigations will be required during the early growth, as the object is to secure a rank growth of straw and the crop is cut when the grain is in the milk. The number of irrigations varies from one in the colder climates to five or six in the hot, dry climate of Arizona.

QUANTITY OF WATER REQUIRED

The quantity of water to be applied at each irrigation depends upon the number of irrigations, the depth of soil, the nature of subsoil, the purpose for which the grain is grown, the condition of the crop, climatic conditions, and, from a practical standpoint, the length between water turns, also the available supply, the method of application, the requirements of other crops, the expertness of the irrigator, and the length of time the field has been under irrigation and cultivation.

The quantity of water applied to the crop for the first irrigation varies greatly. As a general rule, the soil is driest at that time and more water will be required than for subsequent irrigations. It is always safe to assume that the ranker the growth of straw the greater will be the quantity of water required at the time the head is making. Water is plentiful in early spring, but at the time the grain is filling the supply usually begins to fail. The general practice is to irrigate heavily in the spring and use less water as the season advances. Often, however, best yields are obtained by the use of the smallest quantity of water at the first irrigation in case only a limited supply is available for the second and third irrigations, in order to hold down straw growth.

On light, well-drained soils underlain with gravel the mistake frequently is made of applying 12 inches or more at each irrigation, while on the heavier and more impervious subsoil it may not be possible to apply more than 4 to 6 inches. From the standpoint of economy of water these quantities might better be reversed, as the heavier soil will retain a large part of the water applied, while the sandier soil will lose much by deep percolation. An average first application is 8 to 10 inches; the second application averages 2 inches less. The third irrigation, which may occur when the water is scarce and in demand for other crops, is likely to be lighter than either the first or the second. The best results will be obtained usually with three irrigations, the first 7 to 8 inches and each of the others 6 inches. These quantities represent the water applied to the crop in the field and do not cover canal losses.

The total annual volume of water applied to the grain crop on the older lands will vary from 1 to 4 acre-feet per acre, the larger quantities being used on the more porous lands and in the warmer climates. An average volume of 1.5 acre-feet per acre will about represent the quantity applied to the crop in the cooler climates and 3 feet in the warmer climates. However, in some sections, as the Imperial Valley, Calif., only about 1.5 feet is applied to barley. This does not include the water lost before it reaches the farm. The losses in canals and laterals will average from 1 to 3 per cent per mile, while in gravel and loose material the losses are frequently 10 to 20 per cent per mile. These losses, together with those from the distributing ditches and losses resulting from careless irrigation, will average at least 50 per cent.

The quantity of water required by new land usually is more than that needed by older land. Very few data are available from which to judge the water requirements of new land, but it is usual to assume that during the first two or three years 50 to 75 per cent more is required than for old land and 20 to 25 per cent more for the following two years.

The areas watered by Bear River Canal in Utah afford an excellent illustration of the relative water requirements of new and old lands. During the first few years of irrigation in Bear River Valley a second foot of water was used on 60 to 80 acres, and apparently the land required that quantity. Twenty years later the area actually served by a second-foot of water averaged for all crops 116 acres and for grain crops 163 acres. This represents all the water the farmer actually wanted to apply, as the canal company was under contract to supply a second-foot for each 80 acres. This decrease in the use of water is attributable to the fact that new land has a dry subsoil as a rule and the unevenness of the surface causes much loss from run-off. It is further a result of more careful farming, a better understanding of the water requirements of the crops, a better tilth of the soil, and, very largely, the gradual rise of the ground-water level. Where the ground-water level was 15 to 30 feet below the surface in 1890 it rose to within 3 to 8 feet of the surface in 1905. Drains have since been installed to relieve this land of the surplus water.

What is true of the Bear River Valley is more or less true of all the older irrigated valleys. The experience has been that the ground water gradually rises with continued irrigation. The water level will be highest in the latter part of the irrigation season, gradually subsiding after irrigation has ceased. In many localities the lower lands have been completely waterlogged and made worthless until drained as a result of excessive application of water and the seepage from canals and ditches.

The quantity of water required at the source of supply under average conditions varies with several factors, as heretofore indicated. If it be assumed that the grain requires 1.5 to 3 acre-feet and this quantity represents but half of the water turned into the canal, the quantity of water required at the source of supply will average 3 to 6 acre-feet per acre. This corresponds very closely with the quantity found in practice. For new lands during the first few years it will be found that 50 per cent more than the above estimate may be necessary, while frequently in older sections 2 to 4 feet is ample.

RELATION OF IRRIGATION TO RATE OF SEEDING

In raising grain, both with and without irrigation, it has been found that the best rate of seeding depends upon the available supply of water, upon soil conditions, and other factors. If there is plenty of water, the land should be seeded heavily, but if the water is scarce the seeding should be lighter. Experiments in Utah have demonstrated that 1 bushel of wheat to the acre is sufficient when only a moderate supply of water is used, and that when water is scarce three-fourths of a bushel per acre will give larger returns than will heavier seeding.

DANGER OF FAILURE

Partial failure under irrigation may result from the following causes: The application of so much water as to drown the grain or delay its ripening; the application of too little water, resulting in a shrunken kernel; the application of large quantities of water at the wrong time or too light an irrigation during the filling stage. Grain on heavy soils may be burned or the ground may bake so hard that the grain is injured. In an area containing much alkali the salts may be brought to the surface in large quantities, fouling the land and destroying the grain. Unfavorable weather conditions, such as wind, rain, hail, and frost, may cause serious injury.

VALUE OF IRRIGATED GRAIN LAND

In the larger part of the irrigated section the water has a greater value than the land, there being plenty of land and a very limited water supply. The values of water and of land are very hard to determine separately. Improved land, and especially land devoted and planted to the more valuable crops, such as orchards and truck crops, often is regarded as having high value; yet were this land deprived of its water right it might be valueless. In a new locality land values usually are much lower than in older sections. Very little grain is grown on the land of high value or with high-priced water rights except in rotation with other crops.

Grain is essentially a crop for the farmer with a very limited capital or for the farmer on new land. It is not advisable, however, to grow many crops of grain in succession on new land, as the yields fall off rapidly. After the first year or two grain should be used only in rotation with other crops. It is not a dependable revenue crop for small farms or where intensive farming may be practiced.

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May 1, 1928

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1557

INSECTS ATTACKING THE PEACH IN THE SOUTH AND HOW TO CONTROL THEM

1862 1889

THE PLUM CURCULIO, San Jose scale, and peach borer are responsible for about nine-tenths of the damage caused by insects in peach orchards in the South. In addition, 15 other insects do more or less damage.

This bulletin contains brief descriptions of these insects and their work and presents methods for controlling them.

Experience has shown that much of the loss caused by insect attacks in peach orchards of the South can be prevented by the thorough and timely application of the control measures recommended in this bulletin.

Washington, D. C. Issued May, 1928

INSECTS ATTACKING THE PEACH IN THE SOUTH AND HOW TO CONTROL THEM

By Oliver I. Snapp, *Associate Entomologist, Division of Deciduous Fruit Insects, Bureau of Entomology*

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THREE INSECTS of major importance attack the peach in the Southern States. These are the plum curculio,[1] San Jose scale,[2] and peach borer,[3] and at the present time 90 per cent or more of the total damage caused to the peach by insects in this region may be attributed to these species. Other insects of less importance that sometimes attack the peach in the South are the oriental peach moth,[4] shot-hole borer or fruit-tree bark beetle,[5] lesser peach borer,[6] grasshoppers,[7] peach-twig borer,[8] corn-ear worm,[9] terrapin scale,[10] West Indian peach scale,[11] squash bugs,[12] southern green plant bugs,[13] spotted cucumber beetle,[14] blister beetles,[15] tarnished plant bug,[16] green June beetle,[17] and rusty-brown plum aphid.[18] This bulletin gives a brief description and life history of each of these insects and enumerates measures for their control.

THE PLUM CURCULIO

The plum curculio, or peach worm, as it is frequently called by peach growers, is the most serious insect pest that directly attacks the peach fruit in the South, where it annually destroys or renders unmerchantable vast quantities of fruit. In 1920 this insect damaged the peach crop in Georgia alone to the extent of over $2,000,000. However, this does not mean that curculio-control measures are ineffective, as experimental data and practical experience both have shown that the insect can be controlled effectively by thorough and timely spraying, reenforced, in cases of unusually heavy infestation, by supplementary control measures. By the use of the proper sprays at the right time, fruit showing less than 2 per cent curculio infestation has been produced in orchards where the insect had been unusually abundant. In the absence of control measures, over one-half of the fruit is sometimes wormy, or is gnarled from curculio feeding punctures.

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[1] *Conotrachelus nenuphar* Hbst.
[2] *Aspidiotus perniciosus* Comst.
[3] *Aegeria exitiosa* Say.
[4] *Laspeyresia molesta* Busck.
[5] *Scolytus rugulosus* Ratz.
[6] *Aegeria pictipes* G. & R.
[7] Several species of the family Acrididae.
[8] *Anarsia lineatella* Zell.
[9] *Heliothis obsoleta* Fab.
[10] *Lecanium nigrofasciatum* Perg.
[11] *Aulacaspis pentagona* Targ.
[12] Several species of the family Coreidae.
[13] *Nezara viridula* L. and other species.
[14] *Diabrotica duodecimpunctata* Fab.
[15] *Pomphopoea aenea* Say.
[16] *Lygus pratensis* L.
[17] *Cotinis nitida* L.
[18] *Aphis setariae* Thos.

The plum curculio is a native American insect, and is widely distributed east of the Rocky Mountains, being especially abundant in the Southern States. It is not known to occur west of the Rocky Mountains. The females injure the fruit by puncturing it for egg deposition; the result is a wormy peach (fig. 1), while both sexes cause gnarly fruits by making punctures in feeding (fig. 2).

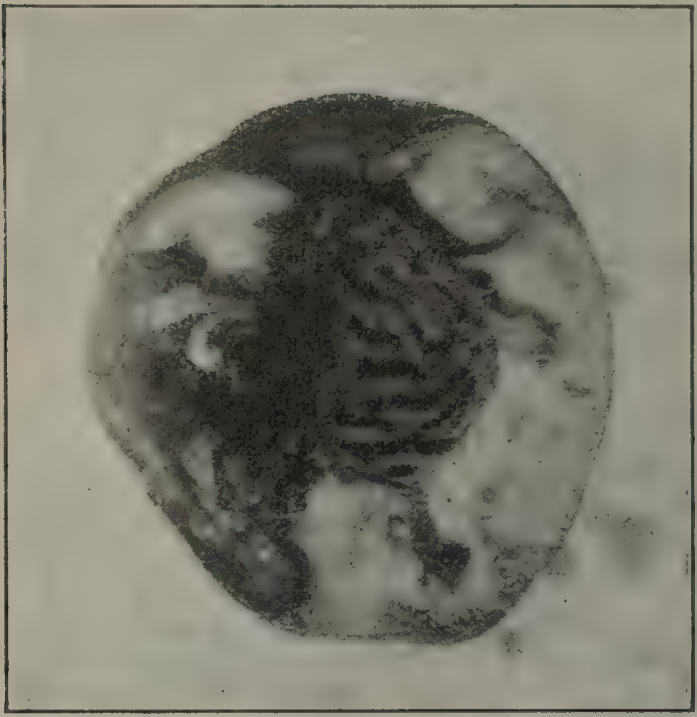

FIG. 1.—Peach showing larva or "worm" of plum curculio. Two-thirds natural size. (Quaintance)

The curculio not only damages the peach directly, but the rupture of the skin for feeding or egg laying furnishes a place for the brown-rot fungus to enter. Many of the brown-rot infections in southern peach orchards start in this manner. Therefore, a heavy curculio infestation opens the way for brown-rot infections.

A majority of the small peaches that are punctured by the curculio early in the season fall to the ground within a few weeks after the calyxes, or "shucks," have been pushed off. However, the worms remain in them and grow until, having reached maturity, they make their way out of the fruit and enter the soil to transform to adult beetles. Two generations of the plum curculio frequently occur in the South, and during seasons when the insect is two-brooded, the eggs for the second generation are laid by the beetles that are reared from eggs deposited in the small peaches. Therefore, during those years, the worms in the late varieties of peaches in southern orchards are mostly second-generation larvae.

LIFE HISTORY AND HABITS

The plum curculio passes through four stages in its course of development, namely, the egg, the larva or worm, the pupa or stage of transformation, and the adult or beetle. The adult is a hard snout beetle, is about three-sixteenths of an inch in length, and of brown color mottled with gray. (Fig. 3.) The egg of the curculio is rather elliptical in shape and has a smooth shiny surface and whitish color. The full-grown larva, or grub, is about three-eighths of an inch in length, and is of a yellowish-white color with a brown head. (Fig. 1.) The pupa measures from one-eighth to one-fourth of an inch in length and is white.

The insect passes the winter as an adult under leaves, grass, bark, sticks, and rubbish in woodlands adjacent to and near peach orchards, and under grass and trash in the orchard or along terrace rows and fences. Bermuda grass and Johnson grass perhaps furnish the best hibernating quarters in and near the peach orchards. The beetles start to leave hibernation in the South just before full bloom of the peach, and they are usually in the orchards in numbers by the time the trees are in full bloom. Immediately upon arriving in the orchard from hibernation the beetles start to feed on the blooms, particularly the calyxes, and to some extent on the unfolding leaves. Mating takes place during this period of heavy feeding, and by the time the calyx splits from the small peaches the females are ready for egg laying. The egg is deposited in a small cavity, which the female makes with her snout, just under the skin of the peach, after

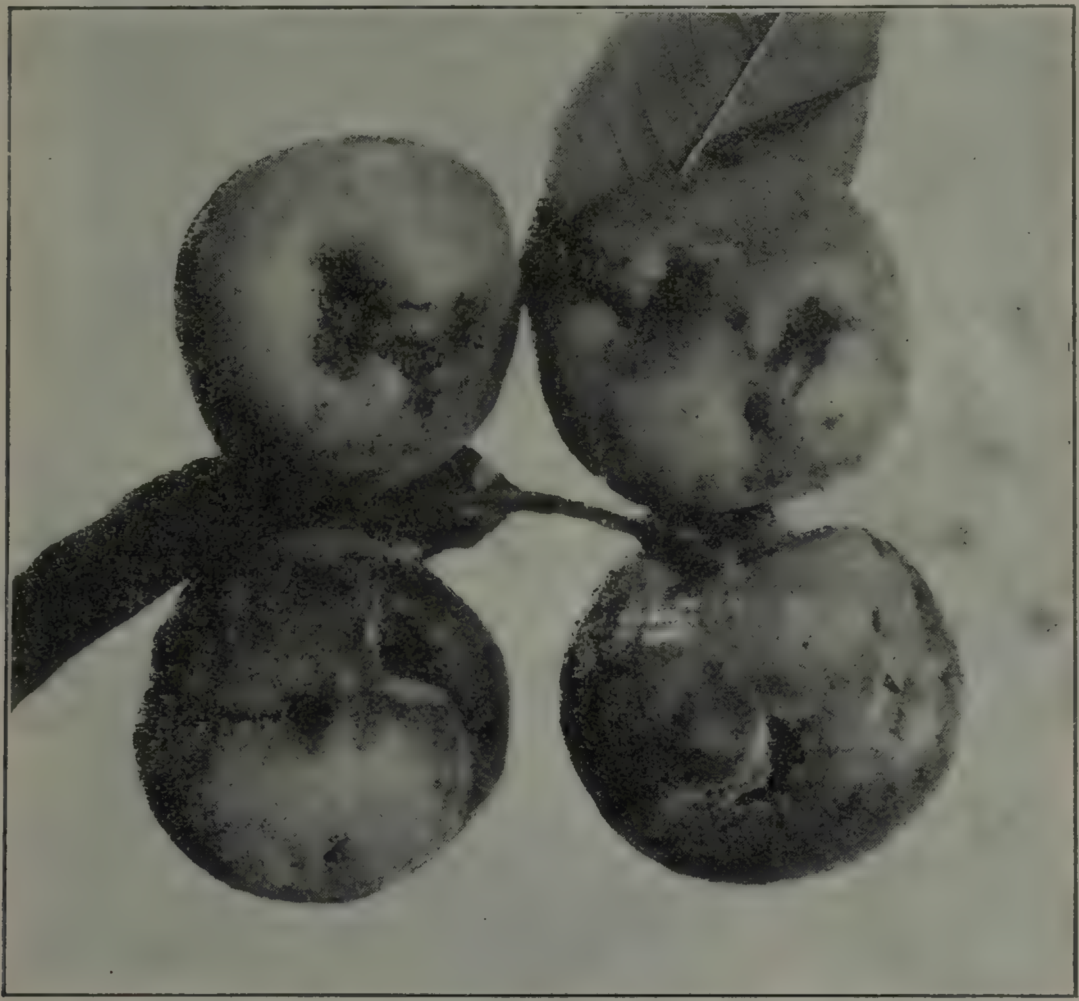

FIG. 2.—Peaches gnarled as a result of curculio feeding and egg-laying punctures. (Quaintance)

the fuzz has been neatly brushed back. The incubation period of the egg ranges from 2 to 12 days, depending upon weather conditions.

Upon hatching, the small larvae or worms begin feeding on the flesh of the peach, in most cases boring into it until the pit is reached. The larvae reach maturity in the fruit in about two weeks, when they eat their way out and enter the soil to pupate. Transformation from larva to adult takes place in a soil cell, constructed within 2 or 3 inches of the surface. The time spent in the soil by the curculio as a pupa is about 10 days, and the entire time spent in the soil as larva (in preparing the cell), pupa, and adult (before emerging) is 30 to 35 days. Therefore from 50 to 55 days is required in the South for the curculio to complete its life cycle from egg to adult. Weather conditions greatly influence the length of each stage in the development.

Two generations of the plum curculio are usually reared in southern peach orchards when an early spring causes the overwintering adults to leave hibernation before the normal time, and when favorable climatic conditions prevail during the time that the insect spends in the soil for pupation. When the beetle is kept in hibernation by cold weather until the latter part of March or when a cold April or May retards pupation, only one generation is produced annually. During years when there are two generations in the South all varieties of peaches ripening before the Hiley will not be subjected to the second brood of larvae. The Hiley will usually escape injury, although the last few pickings may show the presence of tiny second-brood curculio larvae, but the Georgia Belle and Elberta will be attacked by second-brood "worms." Second-brood adults emerge from the soil during August. Thus in September, during years when the insect has two generations, there are both first-brood and second-brood adults in the orchards. The beetles migrate toward woodlands or other suitable places for hibernation with the approach of cool weather, and usually by the middle of October they are all in hibernation for the winter.

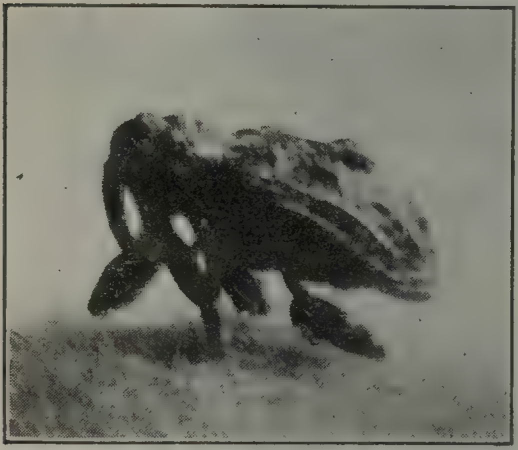

FIG. 3.—The plum curculio; adult beetle. Nine times natural size

CONTROL MEASURES

Spraying or dusting with lead arsenate will afford adequate protection against the curculio in southern peach orchards when a normal infestation occurs. When abnormal curculio conditions occur, as they do sometimes during seasons when the insect is two-brooded, other control measures must supplement the arsenical treatments, if a large cull pile of wormy peaches at harvest time is to be prevented.

The most effective supplementary control measure is the collection and destruction of peach "drops." (Fig. 4, A.) Since a majority of the small peaches that are punctured early in the season by the curculio fall to the ground, the collection and destruction of drops

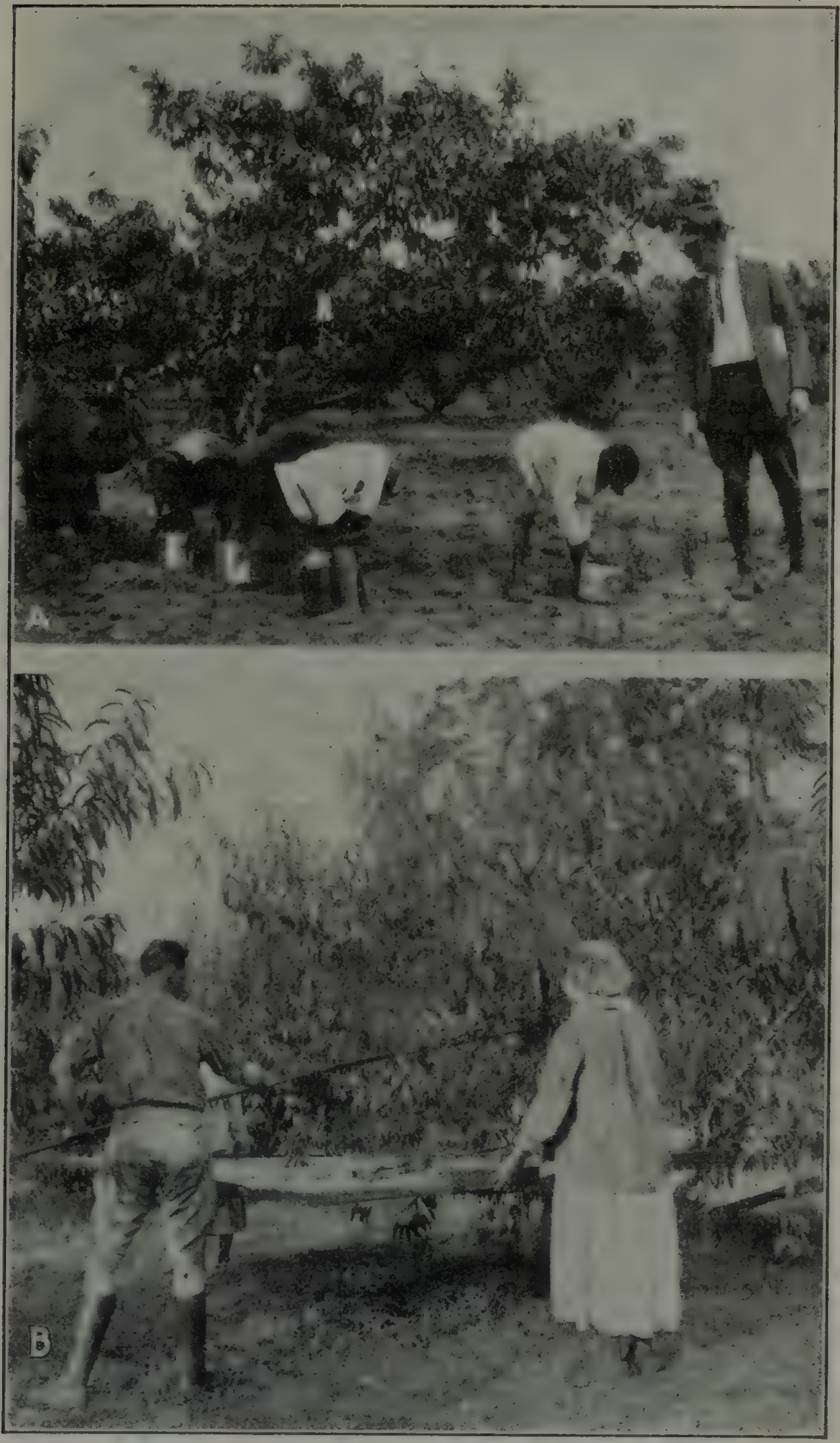

FIG. 4.—A, Picking up peach "drops" in a Georgia peach orchard; B, jarring peach trees to capture adult curculios

prevents the development of many adult beetles (which otherwise would cause wormy peaches at harvest in years when the insect has two generations) and leaves fewer beetles in the orchard after harvest to hibernate and attack the crop the succeeding year. Three collections of drops will get about 90 per cent of the worms that fall to the ground in peaches during the season. The first collection should be made about one month after full bloom, or when there are enough drops down to warrant a collection, and the other two should be made at intervals of five or six days. All drops should be made harmless as soon as they are collected, either by burying in a trench 18 to 24 inches below the surface of the soil and covering with a layer of quicklime before filling in with soil, or by submerging them in boiling water.

Since many curculios winter as adult beetles in woodland and similar cover adjacent to and near peach orchards, the burning over of such places during the winter months undoubtedly destroys many beetles, and is a valuable supplementary control measure wherever the curculio has been particularly troublesome. As most of the hibernation takes place within 200 or 300 yards of the orchard, the burning over of wooded areas should not be extended beyond that distance. In burning woods bordering orchards, great care should be taken not to let the fire escape. Under some conditions burning, as advised, may be objectionable from the standpoint of injury to young forest growth. It is a matter of judgment on the part of the orchardist whether burning is advisable or not. Vegetation on terrace rows and along ditch banks and fences in and near the orchard should also be burned or grubbed out. Sometimes as high as 65 per cent of the beetles that enter Bermuda grass in the fall for hibernation will survive the winter. Prunings, rubbish, and brush piles should not be allowed to remain in the orchard during the winter.

Another supplementary control measure which fits in well with the usual orchard-management program consists of disking under the spread of the trees from about May 10 until the last of June (in Georgia) to destroy curculio pupae in the soil. If the soil cells, which are constructed by the larvae, are broken after the insects have changed to the helpless delicate pupae, the heat and pressure of the soil will cause the death of many of them. In addition to the direct killing of the pupae, the disking perhaps indirectly causes the death of many by exposing them to the elements and to predacious enemies. The disking for destruction of pupae should be frequent, each week if practicable, and to a depth of several inches.

It is possible to collect many beetles in the spring by placing two 6-foot by 12-foot jarring frames under the peach trees and jarring the trees with a padded pole. (Fig. 4, B.) Some growers have found this control measure to be very profitable, especially near woodlands or other hibernating places, where the beetles concentrate just after leaving hibernation in the spring. When the beetles are disturbed, as the trees are jarred, they fold their legs and fall immediately to the sheets, from which they can be collected and placed in a can of coal oil. The beetles are less active early in the morning than at any other time, and jarring can best be done before the sun is very high.

SPRAYING AND DUSTING RECOMMENDATIONS

Spraying or dusting peaches at the several specified times during the period of development of the fruit on the trees is indispensable if the curculio is to be successfully controlled. Since the adult curculios are out on the trees in numbers by the time they are in full bloom, feeding on the calyxes or "shucks," it has been found that an application of lead arsenate when 75 per cent of the petals are down will kill many beetles before egg laying starts. This early application reduces the curculio infestation in the peach "drops," which correspondingly reduces the curculio population at harvest time. As a weapon against a second brood of "worms," and to prevent surviving adults of the preceding winter from ovipositing heavily during the ripening period of the fruit, lead arsenate should always be used on each variety four weeks before the fruit of the variety in question is due to ripen.

As a result of experiments and studies conducted in the South for a number of years, the following spraying and dusting schedules are recommended for use in southern peach orchards for the control of the curculio.

SPRAYING SCHEDULE

First application.—When 75 per cent of the petals (pink part of flower) have fallen, use 1 pound of powdered lead arsenate, with milk of lime from 3 pounds of unslaked lime, to each 50 gallons of water.

Second application.—When the calyxes or "shucks" are shedding, or when the small peaches are exposed (this is usually about 10 days after the falling of the petals), use the same spray as recommended for the first application.

Third application.—Two weeks after the second application, or about four weeks after the petals have been shed, use self-boiled lime-sulphur, 8–8–50, alone, for control of brown rot and scab.[19] (No lead arsenate is used in this application.)

Fourth application.—Four weeks before each variety is due to ripen, spray with 1 pound of powdered lead arsenate to each 50 gallons of 8–8–50 self-boiled lime-sulphur.

If a grower fails to make the first application he should then use lead arsenate in the third application with the self-boiled lime-sulphur, but this should never be done unless for an unavoidable reason the first spray could not be applied. Lead arsenate should not be used in all of the four applications of the above schedule, on account of the risk of injury to foliage and fruit.

Early peaches should be sprayed three times. Use the materials recommended for the first, second, and fourth applications above, applying them at the time specified for these sprays. For added protection against brown rot in early varieties, self-boiled lime-sulphur should be used in the second application.

DUSTING SCHEDULE

First application.—When 75 per cent of the petals (pink part of flower) have fallen, use either lead arsenate 5 per cent and hydrated lime 95 per cent; or sulphur 80 per cent, lead arsenate 5 per cent, and hydrated lime 15 per cent.

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[19] More specific information on the control of brown rot and scab, and on self-boiled lime-sulphur and its substitutes, can be obtained from Farmers' Bulletin 1527, "Peach Brown Rot and Scab," by John W. Roberts.

Second application.—When the calyxes or "shucks" are shedding, or when the small peaches are exposed (this is usually about 10 days after the falling of the petals), use either one of the dust formulas recommended for the first application.

Third application.—Two weeks after the second application, or about four weeks after the petals have been shed, use sulphur 80 per cent, lead arsenate 5 per cent, and hydrated lime 15 per cent.

Fourth application.—Four weeks before each variety is due to ripen, dust it with sulphur 80 per cent, lead arsenate 5 per cent, and hydrated lime 15 per cent.

Early varieties need only three dust applications, using the formula containing lead arsenate and lime, or sulphur, lead arsenate, and lime, at the time indicated above, for the first dusting, and the formula containing sulphur, lead arsenate, and lime at the times indicated above for the second and fourth dustings.

When the curculio infestation during the peach season has been very heavy, postharvest applications of lead arsenate may be found profitable as a protection to the next peach crop, by reducing the number of beetles in the fall before they go into hibernation and while they are forced to feed on the foliage. Two applications of a dust containing 10 per cent lead arsenate and 90 per cent hydrated lime should be used, making the first treatment four weeks after the harvest of the latest variety of peaches, followed by the second application two weeks later. The first application should not be made sooner than four weeks after harvest, as for several weeks following harvest the curculio feeds considerably on the fruit left in the orchard. Postharvest applications of lead arsenate as a liquid spray should not be used after the regular liquid sprays have been given the fruit, on account of foliage injury.

THE PEACH BORER

The peach borer is one of the most serious insect pests that attack the peach tree. Each year it directly or indirectly causes the death of many peach trees in both home and commercial orchards throughout the Southern States. Like the curculio, the peach borer is a native American insect. Although it is chiefly a pest of the peach, it is sometimes a serious pest of cultivated plum trees and has been found breeding in wild plum along the roadside. Peach trees of all ages are attacked, and frequently trees are found to be infested the first year after they are set in the orchard. The injury is done by the larvae as they feed on the cambium or growing tissues of the tree. (Fig. 5.) Young trees are sometimes completely girdled by the insect, and while older trees are less likely to be completely girdled, they are often so severely injured that their vitality is lowered and their resistance to other insects or diseases reduced to such an extent that some secondary pest will complete the destruction of the tree. Peach-borer injury usually takes place on the trunk just below the surface of the soil, although injury may be found on the trunk just above the soil level. The larger roots are also sometimes subject to borer attacks. The presence of borers in a peach tree is usually indicated by gum, particles of wood, and frass. (Fig. 6.)

For many years entomologists endeavored to find an effective control measure for this insect. Their efforts were almost entirely in vain until a few years ago when the value of paradichlorobenzene for its control was discovered. When properly used at the right time, this chemical brings about a high rate of control, and as a result the peach-borer problem has been largely solved.

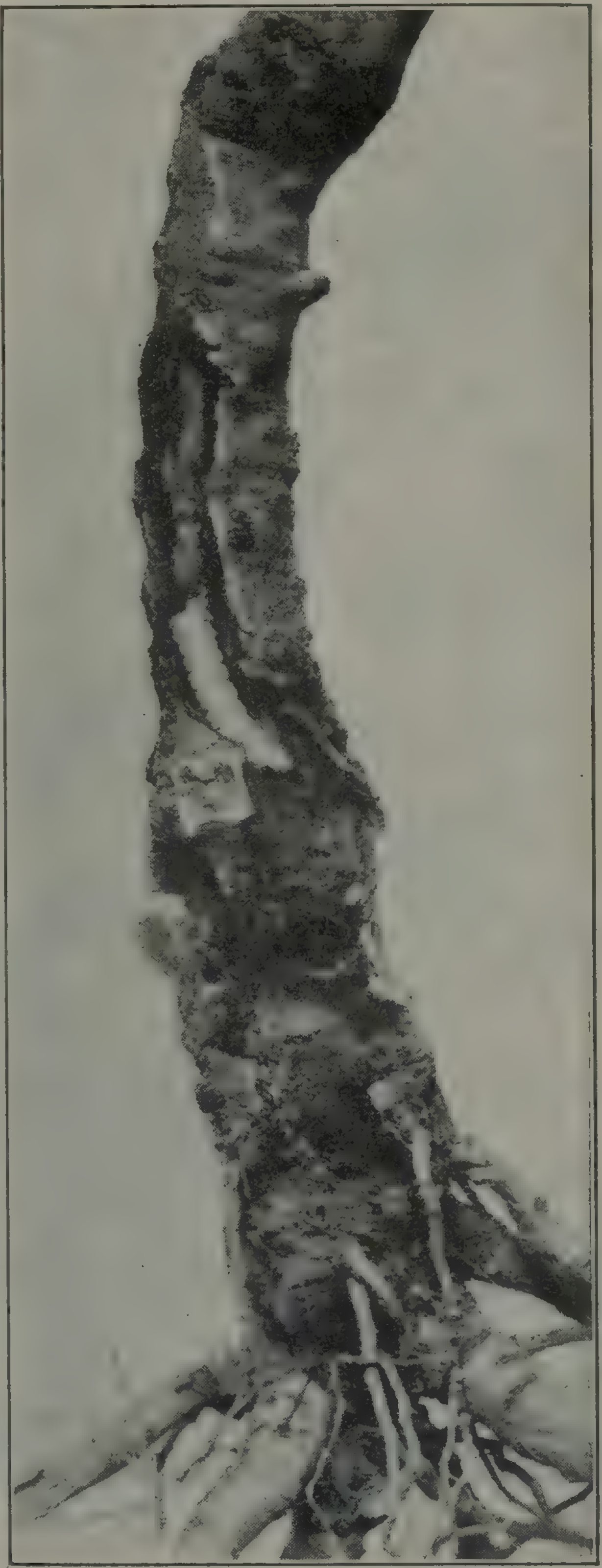

FIG. 5.—Peach tree severely injured by the peach borer. About one-half natural size. (Quaintance)

LIFE HISTORY AND HABITS

During its period of development the peach borer passes through four stages, namely, the egg, larva or borer, pupa, and adult or moth. The adult of the peach borer is a clearwing moth. The female (fig. 7, B) is noticeably different in color markings from the male (fig. 7, A), and is usually larger and more robust. The color of the female is dark steel blue, and it has one orange band around the abdomen. The fore wings of the female are opaque, while the hind wings are clear except for the margins. In the male both sets of wings are clear. The male is a lighter steel blue than the female, and has several narrow yellow bands around the abdomen. The egg of the peach borer is reddish brown in color, has one end broader than the other, and measures about one-fiftieth of an inch in length. The larva or borer (fig. 5), when full grown, measures about 1 inch in length, is of a yellowish-white or cream color, and has a dark-brown head. The color of the food eaten by the larva sometimes causes its color to vary. The pupa has a dark-brown color and measures about three-fourths of an inch in length. There are stiff spines over the back and sides of the pupa that assist the moth in escaping from the cocoon when it is ready to emerge.

The winter is passed in the larva, or borer, stage, the younger larvae living in a more or less dormant condition throughout the winter in a covering constructed on the bark of the tree outside of the burrow, whereas the larger ones pass the winter within their burrows in the bark of the tree, and feed to some extent during warm periods. In the Gulf States the first larvae reach maturity during the latter part of June, when they construct silken capsulelike cocoons into which have been woven particles of wood and excrement, which give the cocoons a brown color. In this cocoon, which is usually found near the surface of the soil, either at the head of the borer gallery or in the soil close to the trunk, the full-grown larva changes to a pupa.

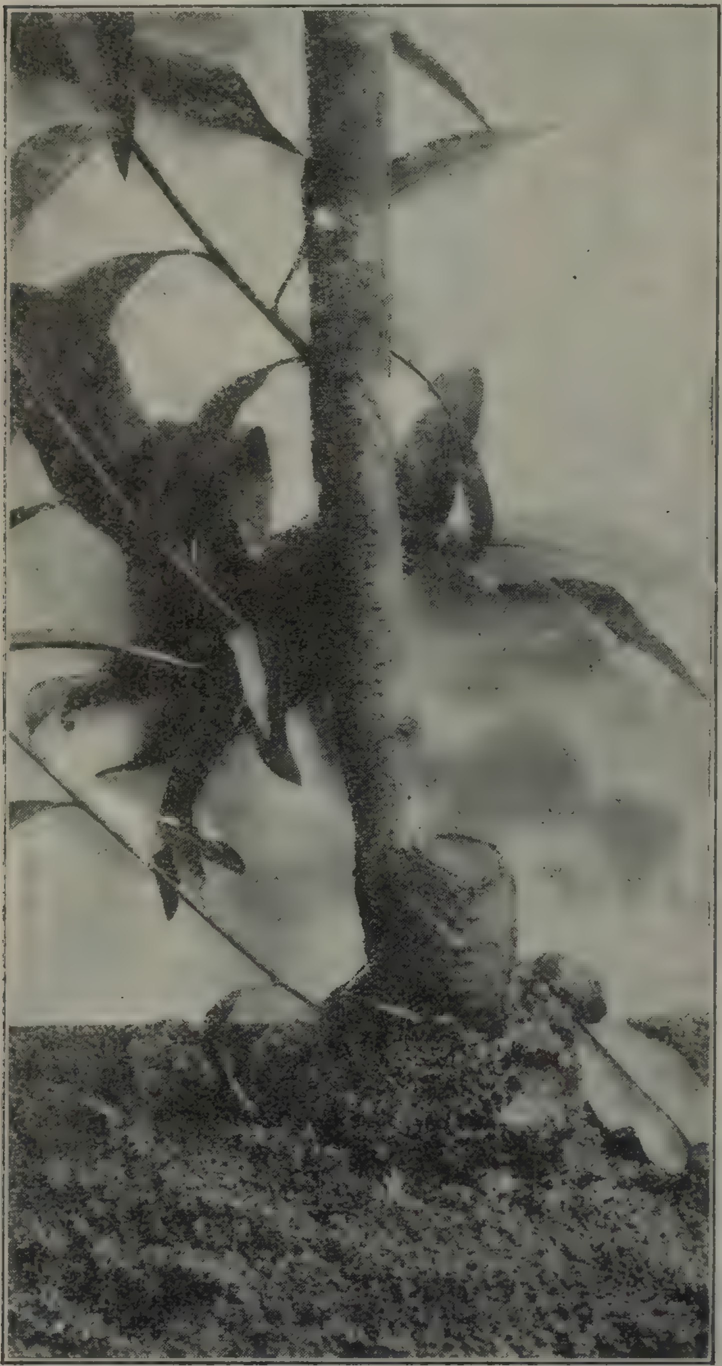

FIG. 6.—Gum and frass at base of peach tree, indicating presence of the peach borer. (Quaintance)

The pupa becomes fully matured in from three to four weeks, when it works its way out of the cocoon, and the adult moth emerges. A few moths may emerge in the southern part of the Gulf States during the latter part of July, but the heaviest moth emergence in the South occurs during September. Oviposition, which usually lasts only a few days, begins shortly after the moths emerge. A female moth usually deposits from 400 to 500 eggs, which are mostly laid on the tree trunk, although some are deposited on the limbs and leaves, and even on weeds and soil near the tree. The length of the incubation period depends on weather conditions. During July, August, and the early part of September, in the South, the eggs hatch in eight or nine days.

Upon hatching the little larvae crawl or fall to the lower part of the tree trunk and usually enter it at the surface of the soil. They may bore directly into the bark, although they sometimes enter a crack in the trunk, and feed rapidly on the bark layers and cambium of the tree after gaining entrance. With favorable feeding conditions they attain considerable size within a few weeks. A few of the late-hatched larvae grow very little before spring, and it is not uncommon to find larvae only one-fourth inch in length during March and April. Practically all of the eggs have hatched, and the little borers are within the trees by October 10 in the latitude of Fort Valley, Ga. From 20 to 30 borers have been found in a single tree;

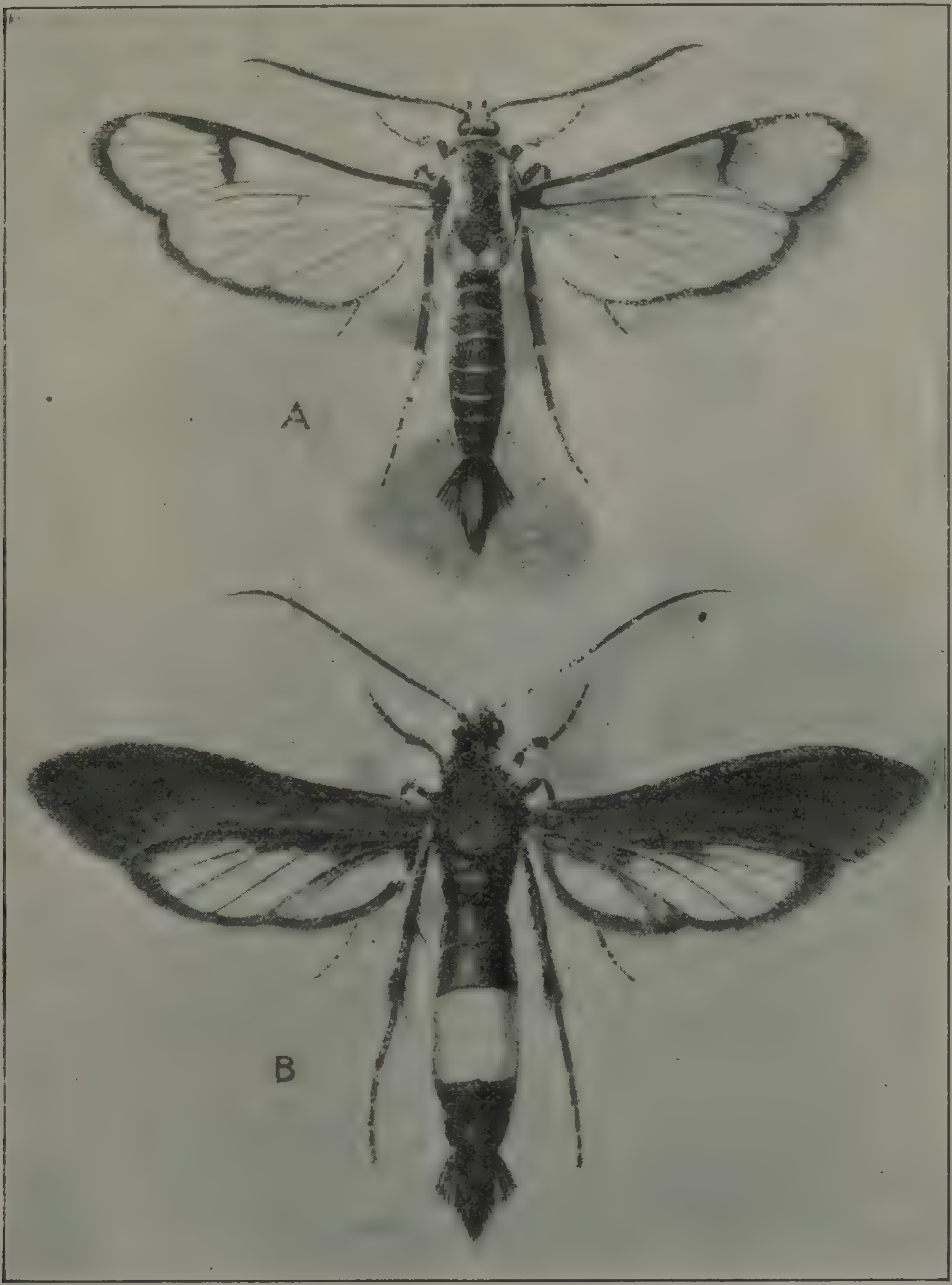

FIG. 7.—Peach-borer adults: A, Male; B, female. Two and one-half times natural size. (Quaintance)

however, the number usually found in peach trees in Georgia will average about 3. There is but one generation annually.

CONTROL

For many years peach growers wormed their trees to protect them from the peach borer. Even at its best, worming is not a satisfactory control measure, as borers are often missed, and the injury to the tree from worming instruments is often more severe than that from the insect. If carefully done, worming will keep the insect in check reasonably well, but it can not be classed as a very effective control measure.

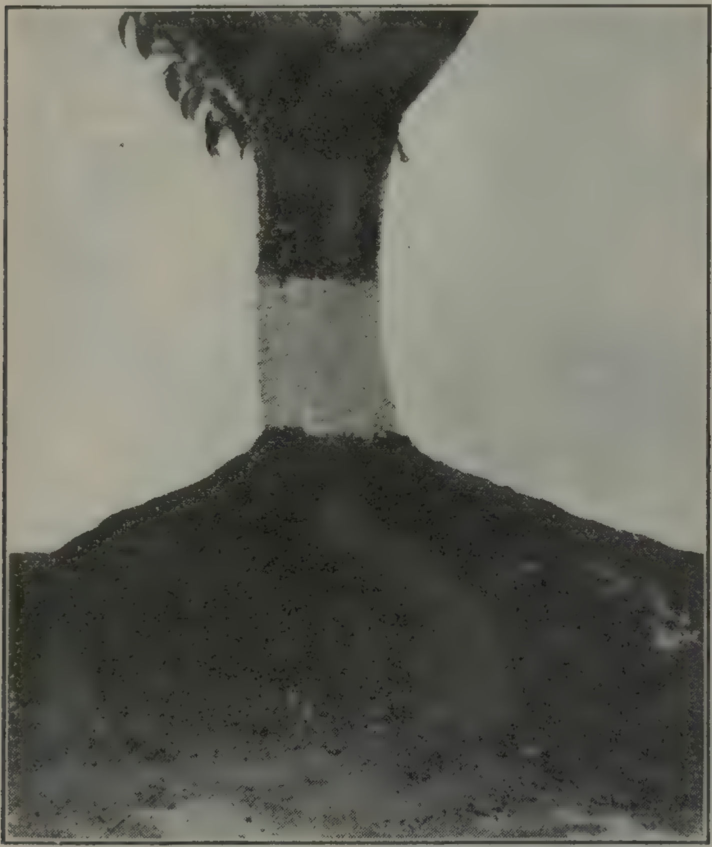
FIG. 8.—Trees that are to be wormed should be mounded during the summer. (Quaintance)

The worming process consists of mounding the trees in early July in the South (fig. 8), so as to force the small larvae to enter the tree higher up than normally. This makes it easier to locate the borers during the worming process in the fall. The worming is usually done in November or December. The mounds are torn down, and the soil is removed from the base of the tree to a depth of 6 or 8 inches. The borers are then removed with a sharp hawk-bill knife. In worming peach trees the incisions should always be made vertically if possible, and care should be exercised not to injure or cut any more of the sound wood than is actually necessary in removing the borers or crushing them in their burrows. After the trees have been wormed, the soil should be replaced around the tree to decrease the possibility of injury to the trees from freezing weather.

PARADICHLOROBENZENE

The work with toxic gases against the peach borer by E. B. Blakeslee, of the Bureau of Entomology, which was begun in 1915 and continued until 1918, demonstrated the value of paradichlorobenzene as an effective control for this destructive peach pest. The continuation of the paradichlorobenzene studies by the Bureau of Entomology at Fort Valley, Ga., from 1921 to 1927, inclusive,[20] and the results of work carried on by several of the agricultural experiment stations, notably those of New Jersey and Illinois, have enlarged the knowledge of the use of this valuable insecticide.

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[20] Technical Bulletin 58, U. S. Department of Agriculture. "Paradichlorobenzene Experiments in the South for Peach-Borer Control," by Oliver I. Snapp and Charles H. Alden, 1928.

Paradichlorobenzene is a white crystalline material, insoluble in water, and it has a characteristic odor somewhat resembling that of ether, which is irritating to the mucous membrane of the nose. Crystals of about the fineness of granulated sugar have been found most satisfactory for peach-borer control. They vaporize slowly at ordinary temperature, and the vapor is much heavier than air. Temperature and moisture greatly influence the rate of evaporation of paradichlorobenzene crystals. The higher the temperature and the drier the soil the more rapid is the generation of the gas from the crystals. Continually wet soil may prevent the normal diffusion of the gas through it, and thereby cause a gas concentration near the ring of crystals. The gas is deadly to insects when confined in the vapor, but is not poisonous to man or domestic animals. When the material is applied properly and at the right time, as specified in the directions given below, a 90 to 100 per cent control may be expected. In addition to the high rate of control, paradichlorobenzene has another advantage over worming in that its use avoids serious injury to the trees, which often results from the use of worming tools in the hands of careless laborers.

AGE OF TREES

Paradichlorobenzene can be used with safety on healthy peach trees 4 years of age and older. It should not be used on trees from 1 to 3 years old, as experiments have shown that these younger trees may be severely injured by paradichlorobenzene under certain weather conditions. It will be necessary for southern peach growers to continue to use the old method of worming 1, 2, and 3 year old trees for borer control.

SIZE OF DOSE

For peach trees 4 or 5 years old, use three-fourths of an ounce of the chemical per tree. For trees 6 years of age and older, of average size, use the full 1-ounce dose per tree. Doses of 1¼ ounces should be used on very old trees, if the trunks are unusually large.

WHEN TO APPLY

Experimentation has shown that best results with paradichlorobenzene for peach-borer control are obtained in the fall at the end of the oviposition period of the insect. At that time the borers are small and more easily killed by the gas. The material should not be applied earlier on account of the possibility of a late infestation becoming established, and on the other hand the application should not be delayed because very little volatilization of the chemical takes place after the soil temperature drops below 60° F. In the latitude of central Georgia the chemical should be applied between October 10 and 15, in north Georgia between October 1 and 5, and in south Georgia between October 15 and 20. In the mountainous section of northeast Georgia the chemical should be applied between September 25 and October 1. Paradichlorobenzene should be applied on the same dates in similar latitudes of other Southern States. The desired results can not be expected unless the material is applied on or very close to the dates recommended, and growers are cautioned to give careful attention to this point.

PREPARING THE SOIL

No preparation of the soil is necessary except the removal of grass, weeds, and trash for about a foot from the tree trunk, and then smoothing the soil surface with the back of a shovel. (Fig. 10, A.) Do not mound the trees before applying the paradichlorobenzene unless borers are working in the tree trunk above the soil level. As the gas from the chemical is much heavier than air, any borers working in the tree above the point where the ring of crystals is placed will not be affected by the gas. (Fig. 11, A.) Consequently it is necessary to place the crystals at least at the level of the topmost borer gallery. Should there be indications of borers working in the

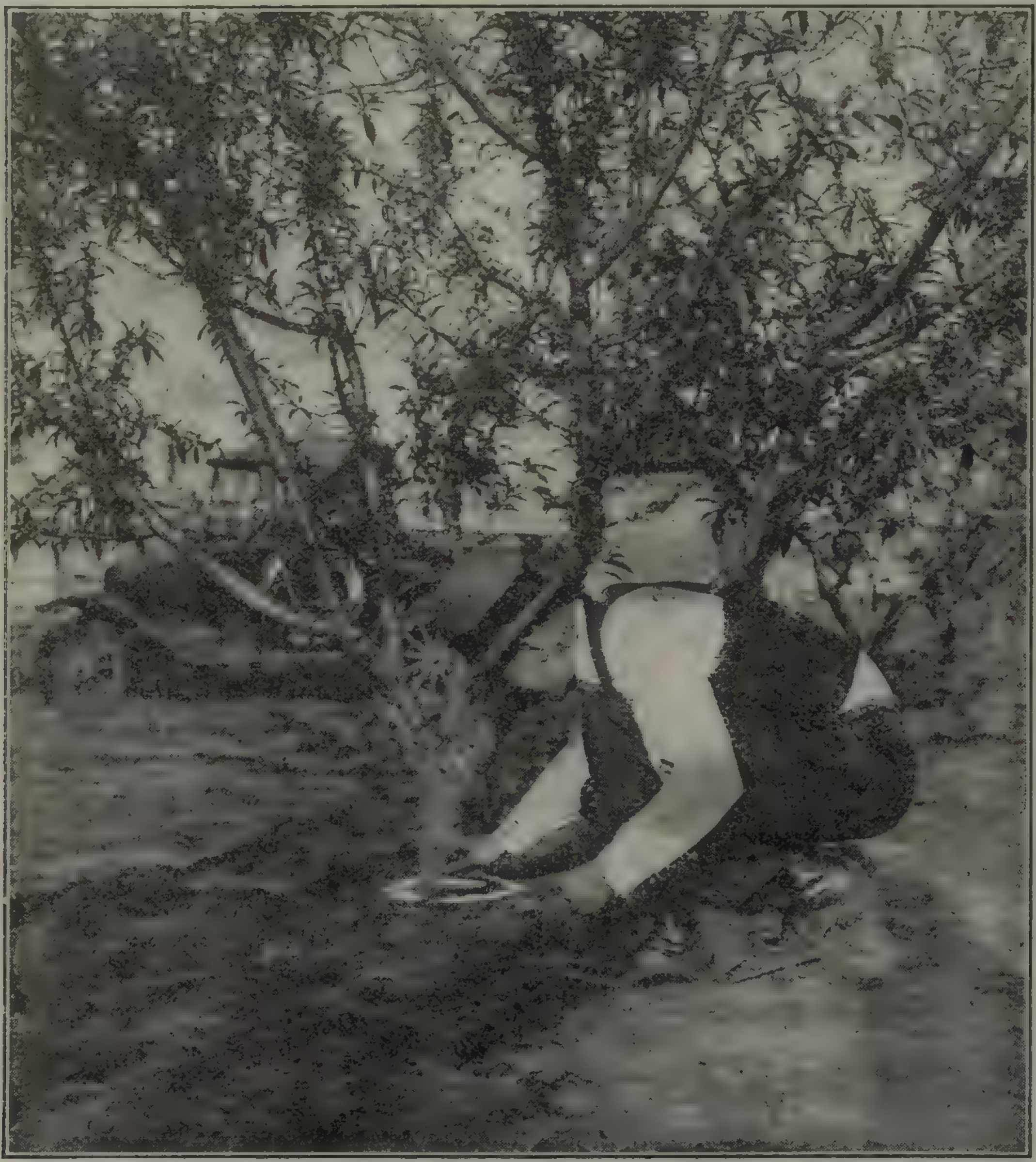

FIG. 9.—Applying paradichlorobenzene with a handy cone-shaped container that holds exactly 1 ounce

tree trunk just above the soil level, sufficient soil should be placed around the tree to bring the level of the soil up above the gummy exudation before applying the chemical.

HOW TO APPLY

The material should be applied in a continuous band about 1 or 1½ inches wide around the tree, and about 1 or 1½ inches from the trunk. (Figs. 9 and 10, B.) Avoid placing the crystals against the tree (fig. 11, B), or too far from it (fig. 11, C). Several shovelfuls of soil free from stones, sticks, and trash should then be placed on the ring of crystals in the form of a mound and packed with the back of a shovel. (Fig. 10, C.) This mound serves as a container for the gas and prevents surface washing of the crystals. The packing of the soil after it is placed on the chemical is important in order to prevent surface loss of the gas. Avoid pushing the crystals against the tree trunk with the first shovelful of soil when covering them.

LATER ATTENTION TO MOUNDS

In using paradichlorobenzene around 4 and 5 year old peach trees, growers are advised to tear down the mounds 28 days after applying the chemical to trees of those ages, in order to remove all unspent crystals and to allow the confined gas to escape. As an added precaution against injury to the older trees, it is also advisable to tear down the mounds six weeks after making the application to trees 6 years of age and older. If the soil is removed from below the original soil level in tearing down the mounds, it should be replaced before cold weather sets in.

GRADE OF PARADICHLOROBENZENE

Orchardists are strongly advised to use only unadulterated paradichlorobenzene, and (when ordering) to specify a grade of about the fineness of granulated sugar. Successful results can not be assured with a compound containing only part paradichlorobenzene and part inert material, since there can be no certainty of the quantity of the chemical present when used.

THE SAN JOSE SCALE

The San Jose scale is a pest of peach, apple, pear, plum, and other deciduous fruit trees, as well as many other plants. The insect takes its nourishment by sucking the sap from the trees, and in this way it is directly responsible for the death of many peach trees each year. The rupturing of the limbs and branches by a heavy infestation of the San Jose scale causes a pitted, diseased condition of the tree which may result in the exudation of droplets of gum.

This insect is thought to have been brought to America from China. It first made its appearance in the United States at San Jose, Calif., about 1870. It has spread over the entire United States, and has taken its annual toll of fruit trees in all parts of the country.

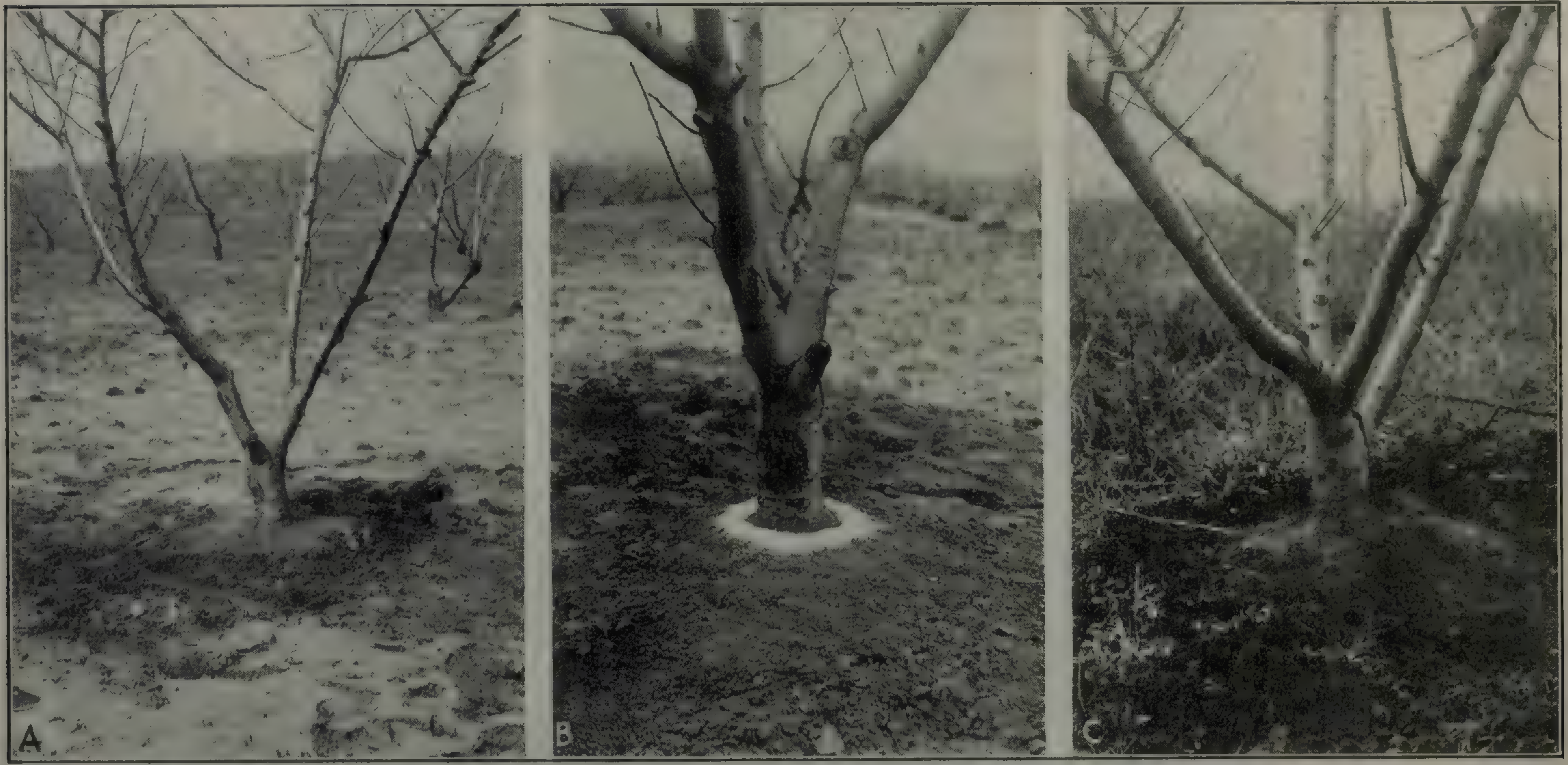

FIG. 10.—Steps in the correct method for treating trees with paradichlorobenzene: A, The soil around this peach tree has been made ready for treatment; B, the ring of crystals should be about 1½ inches wide and 1½ inches from the tree trunk; C, several shovelfuls of soil should be placed on top of the ring of crystals and packed gently with the back of a shovel

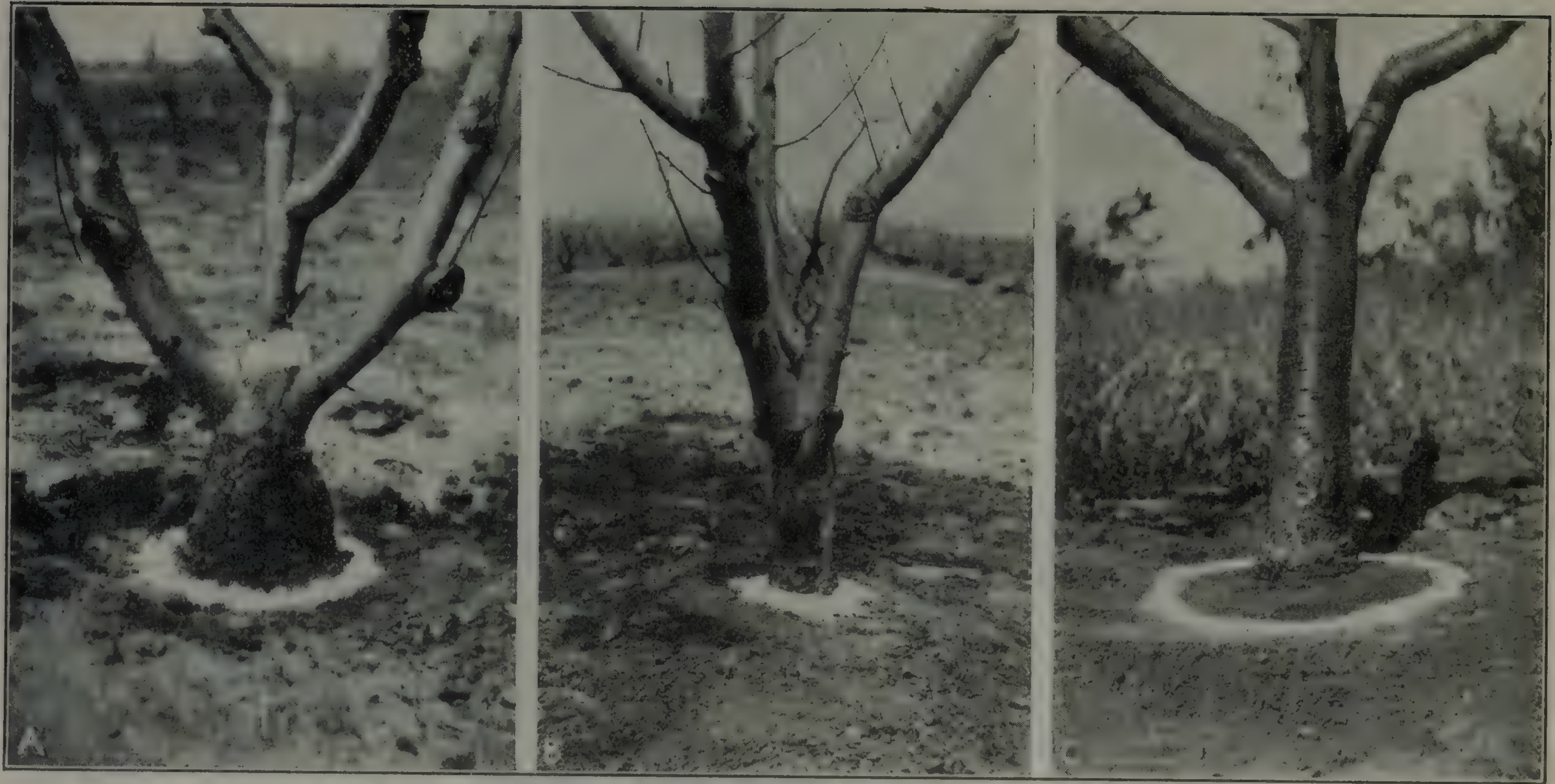

FIG. 11.—Wrong ways of applying paradichlorobenzene: A, The paradichlorobenzene should be placed at a point above the topmost borer gallery; a mound should have been placed around this tree to a point above where the borers are working, so that the crystals could be placed above them; B, if the chemical is placed against the tree trunk, severe injury may result; C, in this case the crystal ring is too far from the tree trunk for effective results

The San Jose scale breeds very rapidly. It has been estimated that the progeny from a single female scale in one season may be over 1,500,000,000 females. In the absence of control measures, a heavy San Jose scale infestation will kill peach trees in several seasons. The first indication of injury to peach trees from this scale is the killing of several limbs or branches. (Fig. 12.) The feeding of the insect will frequently stunt and weaken a peach tree to such an extent that it is especially subject to attacks by other pests which assist in killing it.

The San Jose scale is usually transported from one section of the country to another on nursery stock. Practically all States now enforce laws against the shipment of fruit trees infested by the San Jose scale. Therefore, in buying nursery stock the purchaser should see that the shipment contains a State certificate of inspection showing that the trees are apparently free from the San Jose scale. On trees the insect spreads by the young crawling from one branch to another. Birds frequently carry the crawling young on their feet from one tree or locality to another. Certain insects may also carry the crawlers from tree to tree. In all probability man and domestic animals are agencies in the distribution. Winds also doubtless play an important part in the spread of this pest in orchards.

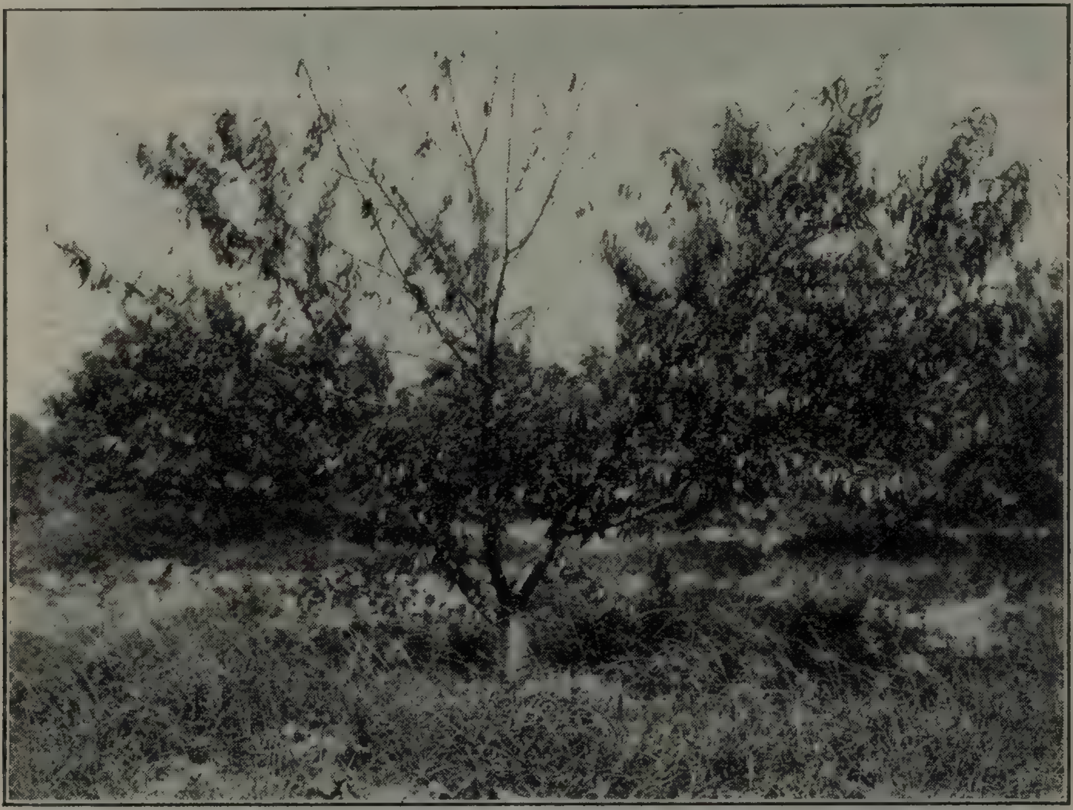

FIG. 12.—Peach tree injured by San Jose scale, several branches having been killed

LIFE HISTORY AND HABITS

The full-grown scale has an ashy-gray appearance, and is somewhat convex, with a slightly raised projection in the center. The female is about the size of a pinhead and circular, whereas the male is smaller and elongated. The insect itself is underneath the scale covering. The gray covering is a waxy exudation of the small, orange-colored, legless insect, which will be found by lifting up the scale covering with the point of a knife. A heavy infestation of the San Jose scale on the bark of peach trees is readily distinguishable by its grayish appearance (fig. 13), and by the yellow oily secretion when the scales are scraped off with a knife. The insect spends the first few hours after birth as a crawling louse, commonly known as a crawler.

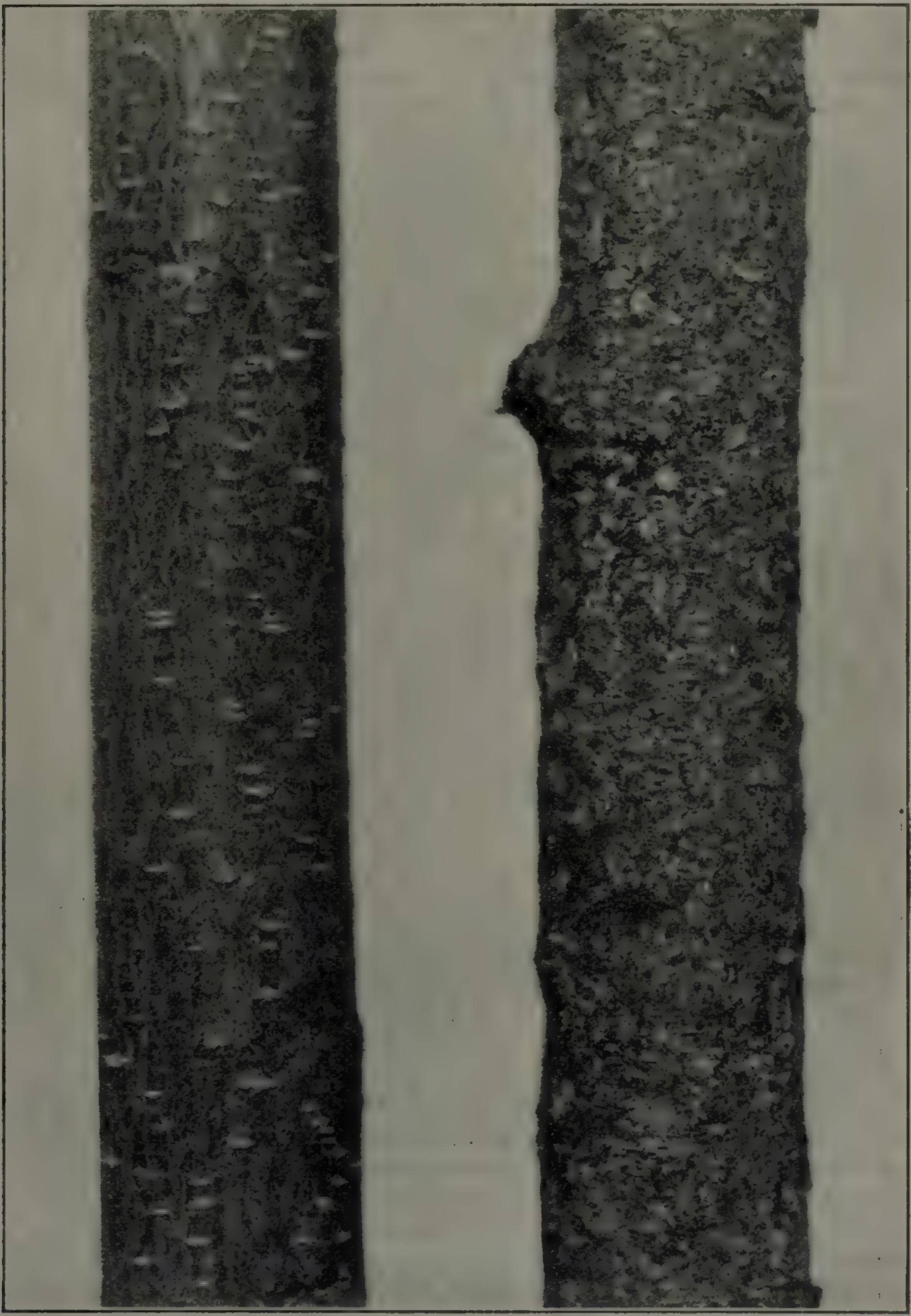

FIG. 13.—Peach twig infested with San Jose scale (right); not infested (left). Twice natural size

During the normal winter in the South the San Jose scale can be found each month in all stages of development from the crawling young to mature adults. Crawlers have been found each month during a normal winter in the South, showing that reproduction is continuous in that latitude. During an abnormally cold winter in the South, such as 1923–24 when the temperature dropped to zero at some points, practically all of the matured and very young scales are killed, leaving only the half-grown or immature insects. When such weather conditions occur the San Jose scale reproduction is, of course, stopped, and does not continue again until the immature scales are full grown, which is usually during April or May. Upon the emergence of the two-winged active males from the male scales, mating with the females takes place, after which the males die. Within several weeks after the mating date, the females begin to produce young crawlers. These active yellow lice crawl around over the tree looking for a place to attach themselves. When a suitable place is found, which is usually only a few hours after birth, the crawler sends its long threadlike beak into the sap cells of the tree for the purpose of sucking out the sap for food, and never moves thereafter from the place of attachment. The waxy covering begins to develop over the insect as soon as it settles down. Within five or six weeks after birth, the females start to reproduce, having been fertilized by the males, which emerge from three to four weeks after birth. A female scale gives birth to an average of about 400 crawlers. There are perhaps six or more generations annually in the South during years when normal conditions prevail.

CONTROL

Lubricating-oil emulsion applied during the winter when the trees are dormant is an effective control measure for the San Jose scale. Liquid lime-sulphur has also been used against this insect for years, and is reasonably effective under usual conditions. As the insect takes its nourishment by sucking the sap, lead arsenate or other stomach poisons are of no value against it. The spray must be one that will produce death by direct contact with the insect. Therefore, in order to insure a high rate of control with either of the materials mentioned above, a very thorough job of spraying must be done, so that it will hit every side of the trunk, lateral limbs, and branches. The concentration of the spray necessary to produce effective scale control would cause heavy defoliation of the trees if it were used during the growing season; consequently the spraying must be done during the dormant season, when there is no foliage on the trees and when the bud wood is seasoned for winter weather.

Whenever a heavy scale infestation has caused the death of some limbs, they should be removed and the tree pruned, if possible, before the dormant spray is applied. Peach trees that have been devitalized by the San Jose scale should receive a fertilizer high in nitrogen the following spring to force out bud wood. If an incrusted infestation of scale has stunted and greatly weakened a peach tree it would be better to remove it during the winter and replant.

LUBRICATING-OIL EMULSIONS

During recent years lubricating-oil emulsions have come into general use for the control of the San Jose scale on deciduous fruit trees. A weak oil emulsion has been in use for a number of years in Florida against certain citrus insects. A few years ago, when the San Jose scale infestation became serious on apple trees in Arkansas, lubricating-oil emulsions twice as strong as those that had been employed in Florida were used and gave very satisfactory results. Some doubt was felt as to the safety of these emulsions on peach trees, and as a consequence experiments on their use on peach trees were started during the fall of 1922 in Georgia by the Bureau of Entomology. The same trees were treated with the emulsion yearly for five consecutive years, with no discernible injury to the buds, twigs, or collars, and with excellent scale control. Therefore its use with safety on peach trees is reasonably well assured.

Since lubricating-oil emulsion is not caustic it is easier to handle, and since spray men will not be trying to dodge a charge of it, a more thorough job of spraying can be accomplished. Furthermore, it is not so hard on spray machinery, hose, and harness as the caustic sprays. Lubricating-oil emulsions can be used earlier in the dormant season in the South than lime-sulphur, as bud wood before it is hardened by cold weather does not seem to be affected by the emulsion.

A 3 per cent lubricating-oil emulsion is recommended for the control of the San Jose scale on peach trees in the South. It should be used only when the trees are dormant, so as to avoid defoliation. Manufacturers are now placing on the market a concentrated lubricating-oil emulsion containing approximately 66⅔ per cent of oil. To make a 3 per cent emulsion, 9 gallons of such a concentrated emulsion to 191 gallons of water should be used. The concentrated material should not be carried over from one season to another, as most emulsions break down with age, liberating free oil which is injurious to the trees.

Both heated and cold-stirred lubricating-oil emulsions are now being used by peach orchardists for San Jose scale control. Both can be made on the farm somewhat cheaper than the manufactured material can be purchased. The heated emulsion is made from the following formula:

Red engine oil, or oil of similar grade (viscosity 125 to 250 seconds, Saybolt, at 100° F.)	gallons	2
Potash fish-oil soap	pounds	2
Sufficient water added to make total volume	gallons	3

Place the ingredients in a kettle and boil for a few minutes until the brown scum, which forms on the top, has disappeared. Then remove the kettle from the fire and pump the contents twice under at least 60 pounds pressure while still hot. The first pumping can be made from the original container into another container, and the second pumping can be back into the original container or into a barrel. This stock emulsion contains 66⅔ per cent of oil, and to make a 3 per cent emulsion for use on peach trees 9 gallons of it should be diluted with 191 gallons of water.

Some growers prefer the cold-stirred emulsion, as it is easier to make. Apparently it gives as good results as the heated emulsion. The following directions should be followed for making the cold-stirred emulsion:

> Add 2 pounds of casein-lime emulsifier with thorough and rapid stirring to sufficient water to make 1 gallon. Pour this mixture, with constant stirring, into 6½ gallons of additional water in a 50-gallon barrel. Then add 15 gallons of red engine oil, or oil of similar grade (viscosity 125 to 250 seconds, Saybolt, at 100° F.). Then place the suction hose in the barrel and start the motor of the spray outfit. When the pressure registers 250 pounds, allow the ingredients to be sucked through the pumps and forced out through one or both spray rods, either with disk removed or with disks having a $\frac{3}{16}$-inch aperture, into another 50-gallon barrel. The emulsion should be passed through the pumps under pressure three times. This stock also contains 66⅔ per cent of oil, and 9 gallons of it to 191 gallons of water is the strength that should be used on peach trees. (CAUTION: In using this formula, do not begin by adding oil to the water, as an emulsion useless for spraying will result.)

Both the home-made heated and cold-stirred emulsions should be used within a week or 10 days after they are made, so as to avoid separation of free oil from the emulsion. If the cold-stirred emulsion breaks down, which is indicated by free oil coming to the top, it can be readily remulsified by pumping.

One thorough application of either emulsion is usually sufficient for satisfactory scale control; however, if necessary, a second application may be used during one dormant season. The soap emulsion should be used with soft water. The casein emulsion can be used with either soft or hard water. If the soap emulsion breaks down in hard water, add ¼–¼–50 Bordeaux mixture to the water before putting in the stock emulsion. Tanks that have been used for lime-sulphur spraying must be thoroughly cleaned before being used for oil-emulsion spraying. Lime-sulphur residue may be removed by running a strong solution of caustic soda through the pumps and by scrubbing the inside of the tank with caustic soda. Examine the stock emulsion for free oil before and after adding water, as free oil indicates that the emulsion is unfit for use and should be discarded or repumped. Never let the stock emulsion freeze (it will freeze at about 15° F.).

LIME-SULPHUR SOLUTION

Lime-sulphur solution is one of the oldest remedies for the San Jose scale on deciduous fruit trees. It has long been considered very effective against the insect, but recent experiments have shown that as a scale treatment it is less effective than lubricating-oil emulsions. It has fungicidal properties, however, which emulsions do not have. Liquid lime-sulphur should never be applied in the South until after two or three killing frosts have occurred, if injury to bud wood is to be avoided. Lime-sulphur may injure new-growth peach wood in the South if it is applied before the wood has been subjected to cold weather. (Fig. 14.) If the scale infestation is heavy, a second application of liquid lime-sulphur may be necessary in the spring before the buds burst.

For years insecticide manufacturers have had on the market concentrated lime-sulphur solutions which need only to be diluted with water for scale spraying. These concentrates usually have a density of 32° or 33° Baumé, and should be used at the rate of 1 part of the concentrate to 7 parts of water for the control of the San Jose scale on peach trees.

The lime-sulphur concentrate may be made on the farm somewhat cheaper than the manufactured material can be purchased. Directions for preparing lime-sulphur concentrate on the farm are given in Farmers' Bulletin No. 1285.[21]

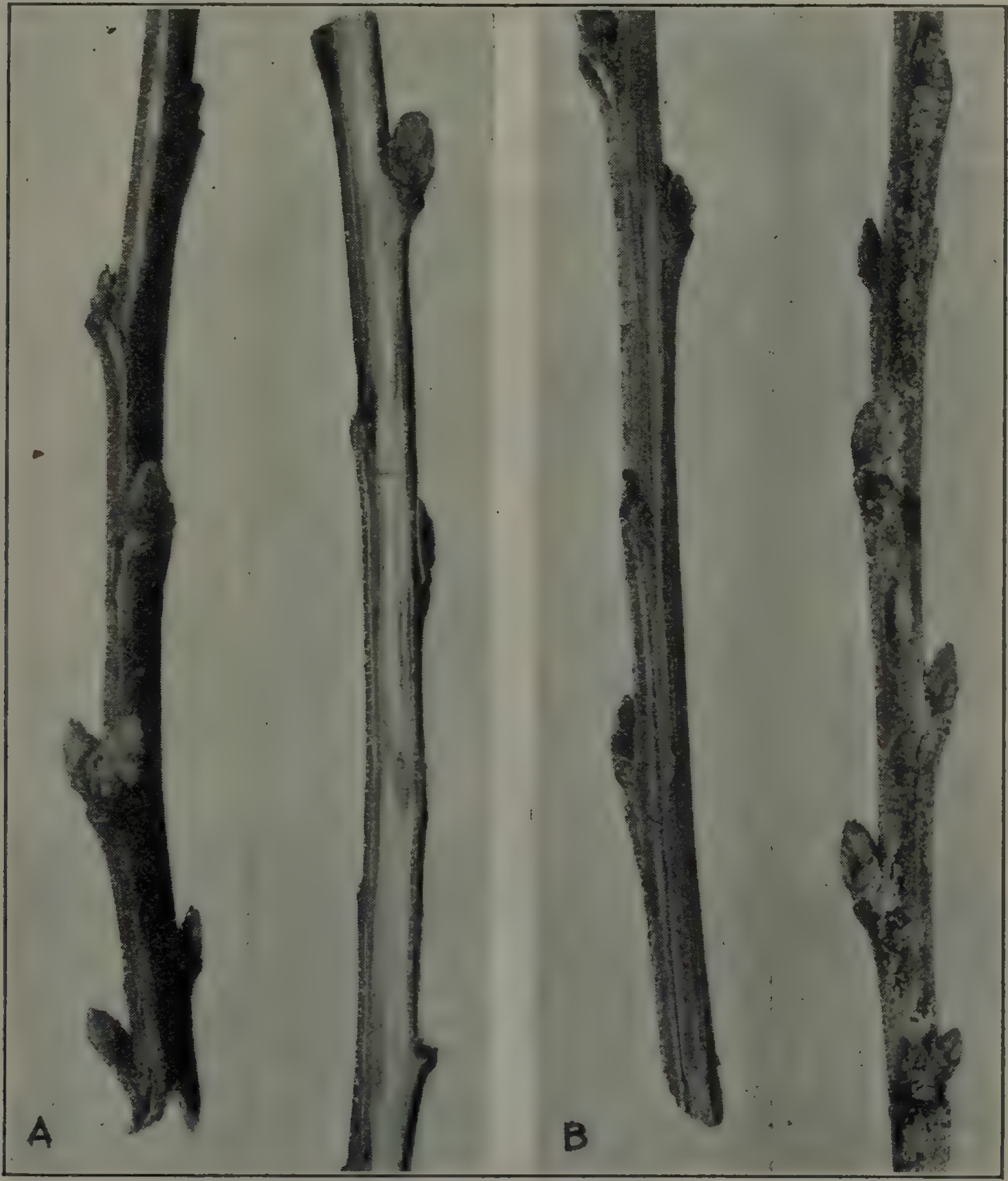

FIG. 14.—Peach bud wood killed by applying liquid lime-sulphur too early (right) ; uninjured bud wood (left)

COMPARATIVE COST OF SPRAYS

In Georgia the liquid lime-sulphur costs about 15 cents per gallon, f. o. b. shipping point. Therefore, the 1 to 7 lime-sulphur dilution costs about $3.75 per 200 gallons of diluted spray. Lubricating-oil emulsions can be purchased from manufacturers for about 25 cents per gallon. Used at the rate of 9 gallons to 191 gallons of water (to form a 3 per cent oil spray), the cost would be around $2.25 per 200 gallons of diluted emulsion. Both of these sprays can be made on the farm for less than the figures given above.

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[21] SIEGLER, E. H., and DANIELS, A. M. LIME-SULPHUR CONCENTRATE, PREPARATION, USES, AND DESIGNS FOR PLANTS. U. S. Dept. Agr. Farmers' Bul. 1285, 42 p., illus. 1922.

MISCIBLE OILS

Miscible oils, which are usually made from petroleum oils, soap, and a third substance, such as cresylic acid, to make the soap soluble in the oil, are sold under several proprietary names for San Jose scale control. Injury to young twigs has been noted at times from the use of miscible oils on peach trees in the South, and therefore they may not be as safe as the two sprays recommended above.

THE ORIENTAL PEACH MOTH

The oriental peach moth was not known to occur in the Southern States until the fall of 1923, when several larvae were detected in peach twigs from the home orchard of R. M. Shaw, Valdosta, Ga. During the following year the insect was found at other points in Georgia, including the peach belt, and in the States of North Carolina, Florida, Alabama, Mississippi, Tennessee, Arkansas, and Texas, and typical injury was found in South Carolina and Louisiana. The insect was brought into the United States from Japan about 1913, and shortly thereafter infestations were found in the District of Columbia, Maryland, and northern Virginia. Before it became established in the South it had spread to a number of Northern States. It is believed that the oriental peach moth was brought to the South in infested apples.

The larva, or worm, of the oriental peach moth damages both the twigs and fruit of the peach. During the spring and early summer, when the new growth of peach trees is tender, the larvae enter the new twigs at the tip, near the base or the axil of a leaf, and eat out the center of the twig as they work downward. (Fig. 15.) One larva may enter several twigs before it becomes mature. Heavy infestations of the oriental peach moth may cause a tree to take on a bushy appearance, on account of the growth of the secondary shoots when new terminal growth is destroyed early in the season. When the twigs harden in midsummer, the larvæ cease to work in them and start feeding in the fruit. (Fig. 16.) They enter the fruit either from the side, near the stem, or through the stem. Injury to the peach fruit by larvae of the oriental peach moth is somewhat similar to that produced by curculio larvae; however, full-grown peach moth larvae are usually pink, whereas curculio larvae are of a creamy-white color.

At present the oriental peach moth infestation is very light in the localities of the South where the insect is known to occur. Up to the present the insect has not been of economic importance in this region of the United States. The chances are that it never will be a pest of major importance in the southern peach sections where there is no late fruit for the maturing of the last three broods of larvae, the ones that normally pass the winter in hibernation. In the central Georgia peach belt the harvest of the latest commercial variety of peaches is usually completed before the last three broods of the oriental peach moth have been produced. By that time the larvae have ceased to work in the twigs on account of their hardened condition. Consequently there is an apparently heavy mortality of larvae of broods that would enter hibernation, owing to the absence of suitable food after midsummer. Dead larvae have been found frequently in peach twigs in Georgia after peach harvest, their death apparently having resulted from an inability to feed in the hardened twigs.

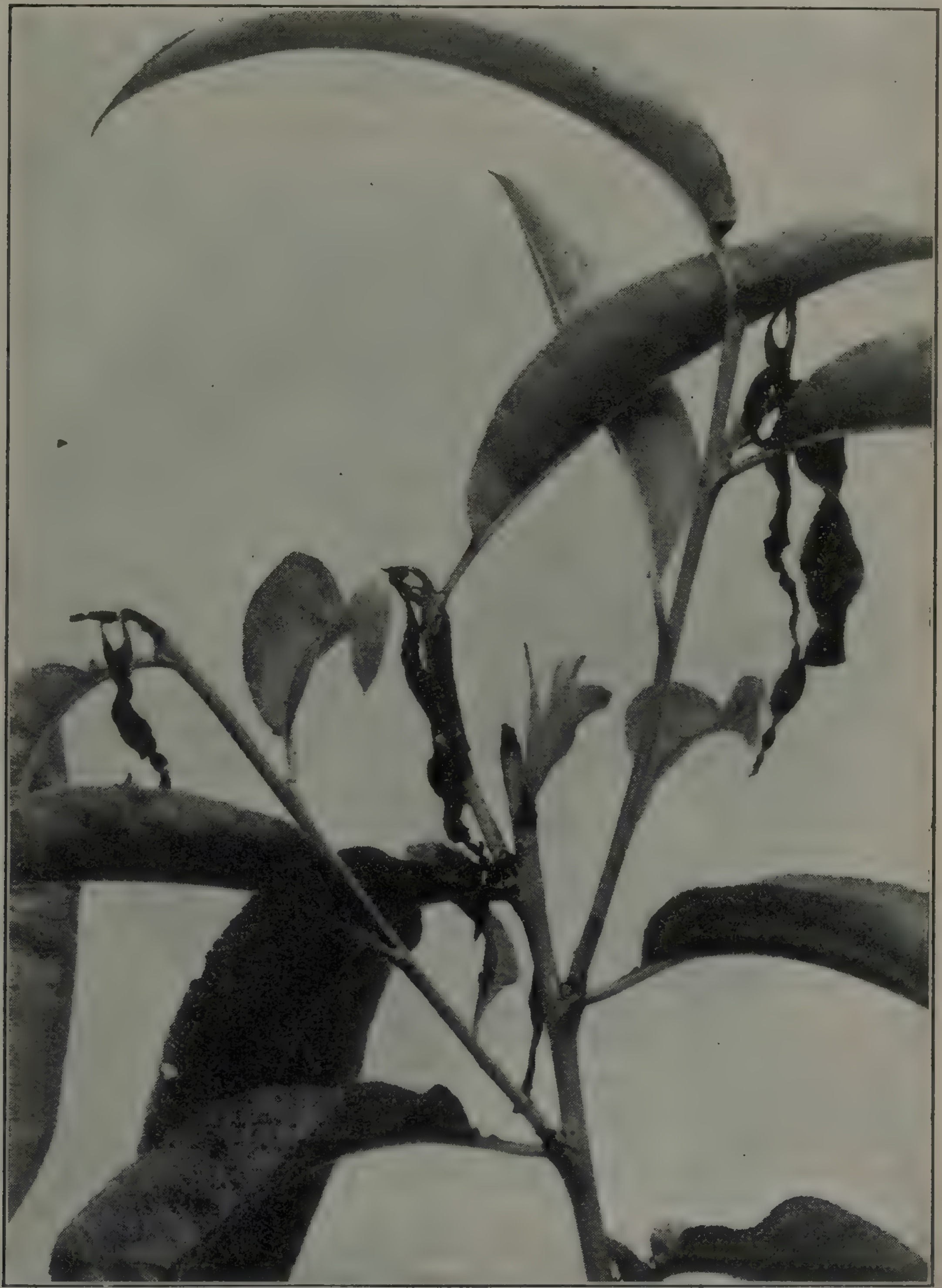

FIG. 15.—Peach-tree twigs injured by oriental peach moth larvae. (Wood and Selkregg)

LIFE HISTORY AND HABITS

The oriental peach moth passes the winter as a larva, or worm, in a cocoon. In the latitude of central Georgia the larvae start to change to pupae during the latter part of February. The insect remains in the pupal state from 8 to 12 days. (The pupal period of the spring brood may last much longer.) Eggs are being deposited by spring-brood moths during full bloom of Georgia peach trees. The egg production per female averages about 40. A single female moth has been known to deposit over 200 eggs. The eggs are deposited chiefly on the under side of peach leaves. The eggs hatch in from 3 to 10 days under southern conditions. The larvae feed in the twigs of peach trees while they are tender, or in the fruit. The larval feeding period averages about 10 days in the summer. From 2 to 4 days on the average are spent by the larvae in constructing cocoons after they leave the host, and while they are in the prepupal stage.

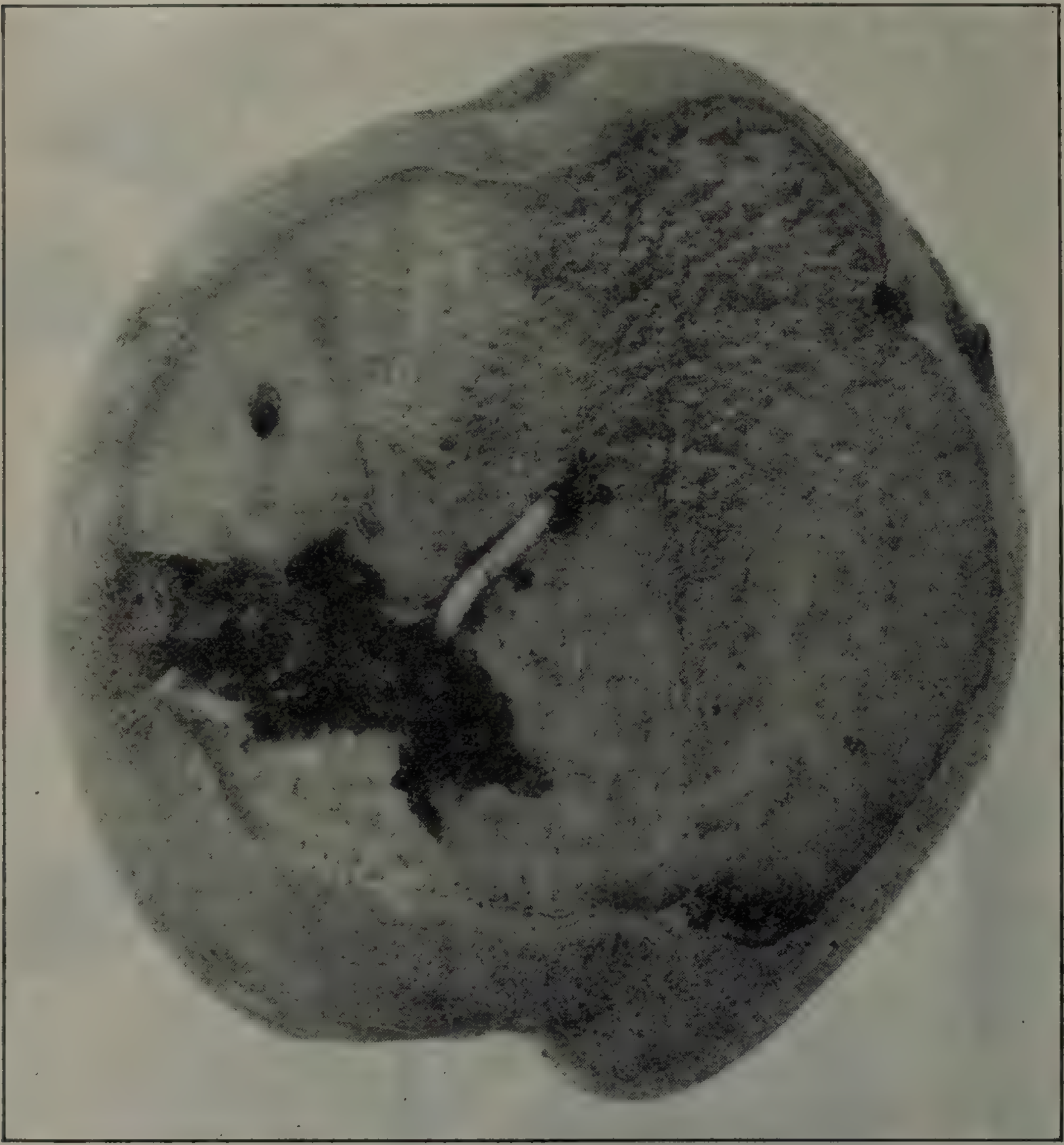

FIG. 16.—Larva of oriental peach moth working in peach. About twice natural size. (Quaintance and Wood)

There are six or seven generations annually in the South. At Fort Valley, Ga., six generations and a partial seventh were reared in the insectary in 1925, and five generations and a partial sixth were reared in the insectary in 1926. In 1925 the first moth of the spring brood emerged on March 8, and the last moth of the sixth brood emerged October 25. There was considerable overlapping of the emergence periods of the last four broods of moths in 1925. In 1926 the first moth of the spring brood emerged on March 28, and the last moth of the last brood emerged on September 27. There was a distinct overlapping of the emergence periods of all broods of moths in 1926. In 1927 the first moth of the spring brood emerged on February 23. In 1925 fourth-brood larvae were making their appearance in the Georgia peach belt during the harvest of Elberta peaches, the last commercial variety to ripen in that State. No larvae of the fourth brood hibernated in 1925. The fifth, sixth, and seventh generations were reared after the peach harvest that year, and 13 per cent of the fifth, 65 per cent of the sixth, and 100 per cent of the seventh brood of larvae hibernated. In 1926 third-brood larvae were making their appearance in the Georgia peach belt during the harvest of the last commercial variety of peaches. No larvae of this generation hibernated. The larvae that hibernated in 1926 were individuals of the fourth, fifth, and sixth broods. Thus the broods of peach-moth larvae that hibernate in central Georgia are not produced until after the fruit has been harvested, and when the twigs have become too hard to be a host for them.

CONTROL MEASURES

Mortality of oriental peach moth larvae of the broods that hibernate in the lower South, owing to the absence of host plants in any numbers after midsummer, may always keep the infestation down to a point where the enforcement of control measures will not be necessary. As the larva of this insect discards the first several mouthfuls of food and does not start to feed until its head is embedded in the fruit or twig, the control of the oriental peach moth presents a very difficult problem. At present no very satisfactory means of control have been found. Thorough spring cultivation reduces the infestation early in the season. Picking up and destroying dropped fruit infested with the larvae would reduce the number of larvae that hibernate. The clipping and burning of infested twigs early in the season may reduce the infestation. Paradichlorobenzene, as used for the control of the peach borer, has been recommended for the control of larvae hibernating in cocoons on the trunks of peach trees near the ground. Bait pans in peach orchards to attract and catch the adult moths have been suggested, but under conditions in the South this method has not been successful or practical.

THE SHOT-HOLE BORER

The shot-hole borer or fruit-tree bark beetle occurs throughout the South, attacking chiefly fruit trees that have been devitalized by some other pest or injured and weakened by some other condition. Occasionally they attack healthy trees that are near diseased ones, which have furnished excellent breeding quarters for the insect. Both the larva and adult beetle burrow into the bark of peach trees. Many small, round entrance and exit holes in the bark of attacked trees reveal the presence of the insect (fig. 17), and frequently growers attribute the unhealthy condition of their trees to these insects, whereas they are only secondary pests working in trees that have been rendered unhealthy by some other cause.

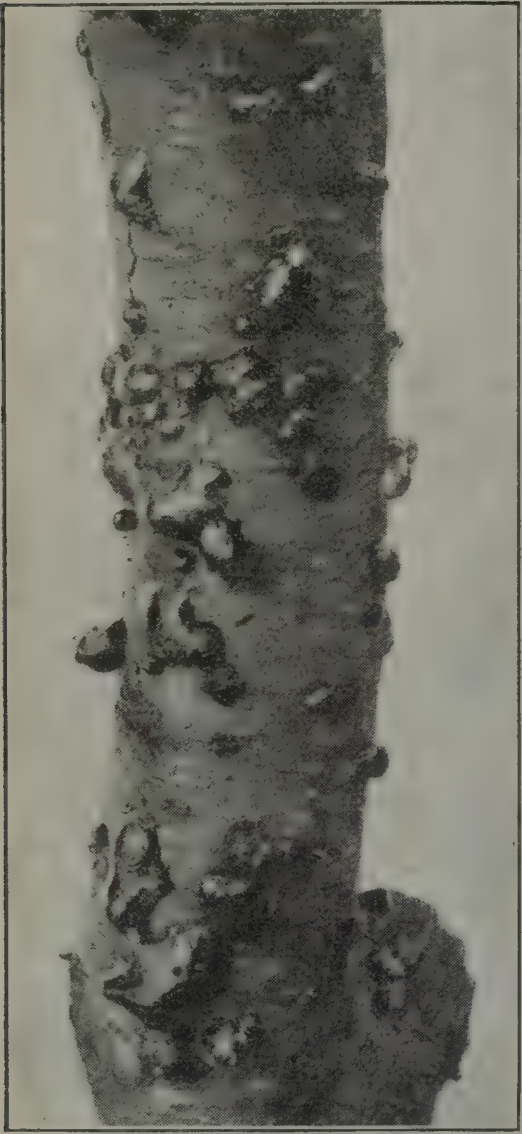
FIG. 17.—Peach limb attacked by the shot-hole borer; gum exuding from holes made by the insect. (Brooks)

LIFE HISTORY AND HABITS

In the spring the small black beetles appear on unhealthy peach trees and eat out a channel between the bark and cambium layer, in which eggs are deposited by the females in small notches. The eggs hatch in several days, and the larvae feed for about a month in burrows under the bark before they begin to pupate. The pupal stage continues for about a week, when the resulting adult beetle escapes through a small exit hole. Soon after emergence the beetles begin to deposit eggs for another generation. There are three or four generations each year in the South. The winter is passed in the larval stage.

CONTROL

The shot-hole borer seldom feeds and breeds in healthy trees, but confines its attack mostly to trees that have been weakened by the San Jose scale, borers, crown gall, winter injury, mice, rabbits, or neglect and starvation. Therefore the elimination of breeding quarters is the most important factor in the control of this insect. Peach trees that have been seriously devitalized should be pulled up and burned. When only a limb or two is affected it should be removed and the tree strengthened by fertilizers and cultural methods. Wild fruit trees and seedlings that may be furnishing breeding places for the insect near an orchard should be removed. Prunings should not be allowed to remain on the ground in an orchard very long after they are cut, as the insect might breed in them.

Peach trees that are infested with the shot-hole borer may be saved by applying a thick coat of whitewash (fig. 18), after the severely infested limbs have been removed, and by heavy fertilization to stimulate the tree. In cases of very heavy infestations the application of thick whitewash should be repeated two or three times during the year.

THE LESSER PEACH BORER

The lesser peach borer confines its attack to the trunk of peach trees, mostly above ground. Only injured or diseased trees are attacked, and the insect is invariably found working in areas on the trunk or limbs that have been injured by implements, cankers, low temperatures, or sun scald, and in crotches or under loose bark of

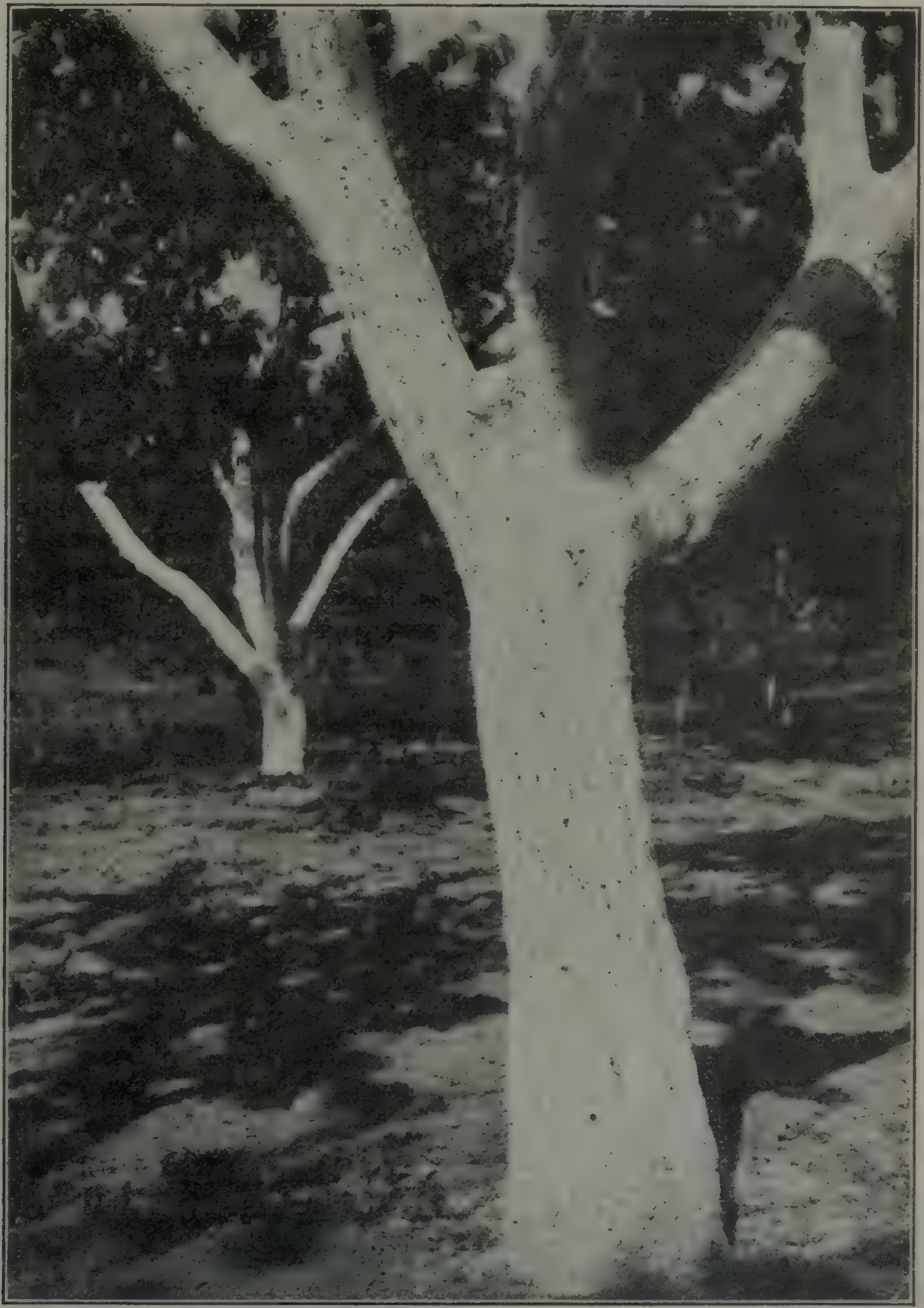

Fig. 18.—A thick coat of whitewash applied to a peach tree heavily infested with shot-hole borers. (Brooks)

old trees. (Fig. 19.) Frequently this insect has been confused with the peach borer (p. 8), on account of the similarity of the larvae and adults. The lesser peach borer occurs in all of the Southern States.

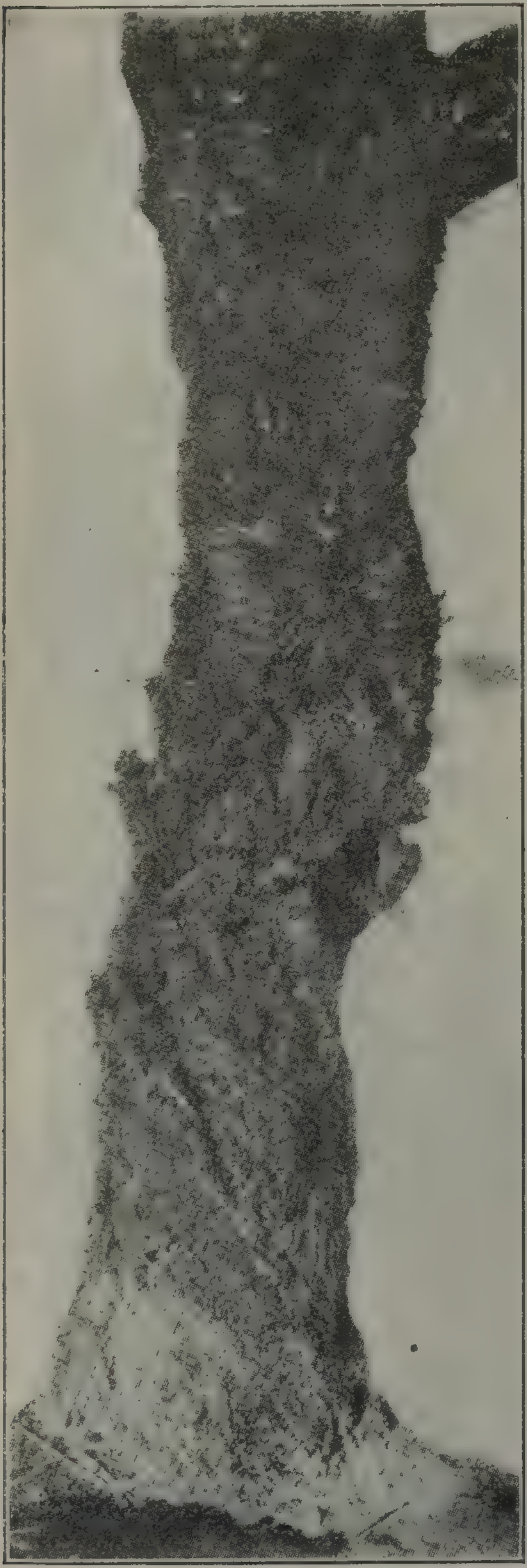

FIG. 19.—Trunk of an old peach tree heavily infested with larvae of the lesser peach borer. (Girault)

LIFE HISTORY AND HABITS

Like the peach borer, the lesser peach borer passes the winter in the larval stage. During late winter or early spring in the South the overwintered larvae change to pupae. The pupal stage lasts from three weeks to one month, when the adult moths emerge. The eggs are deposited along the trunk of the tree, and the incubation period is about one week. Larvae of the summer brood reach maturity within several months, then form pupae, from which come the second-brood moths. The larvae from eggs of second-brood moths hibernate during the winter. Therefore, two generations of the lesser peach borer occur annually in the latitude of central Georgia.

CONTROL

Preventive measures should be employed, as the only available remedy for the lesser peach borer after it has attacked a tree is to dig the larva out and kill it. As the insect attacks injured or diseased areas on the trunk and branches, care should be exercised not to scrape, bark, or otherwise injure the trees with implements while cultivating. Wounds on peach trees should be given prompt treatment, and the trees should be kept in a clean and healthy condition by proper orchard management and fertilization. Limbs broken during peach harvest or killed by low temperatures during the winter should be promptly removed. Cankers and areas killed by sun scald should be cut out before they become infested with the lesser borer.[22]

After the trees have become infested, the only remedy is "worming." This should be done in the fall and spring, when all parts of the trunk and lower limbs should be examined for the larvae. In cutting them out it will be necessary frequently to cut away considerable bark and rough and diseased areas. All such areas and wounds should be thoroughly cleaned out and treated with lime-sulphur or other antiseptic wash. Sprays and washes are of little or no value for the control of the lesser peach borer.

GRASSHOPPERS

Occasionally grasshoppers of several species attack peach trees and feed on the little peaches or foliage. It is not uncommon to find the largest winged grasshopper[23] feeding on half-grown peaches in Georgia orchards. In some cases the entire peach is devoured, while in others the light feeding causes a gnarly condition of the fruit when it is ripe. Other species of grasshoppers, such as the red-legged grasshopper[24] and the differential grasshopper,[25] sometimes feed on the foliage of peach trees, causing considerable damage. During droughts, when there is very little green vegetation to feed on, grasshoppers may almost defoliate peach trees.

LIFE HISTORY

During the fall, grasshoppers lay their eggs in masses below the surface of the soil. The eggs are yellow and are arranged irregularly together and covered with a gluey material. The winter is passed in the egg stage. The young grasshoppers, or nymphs, hatch in the spring, usually during April and May in the South, and start immediately to feed on whatever crops are available. They reach maturity during the summer and lay their eggs during the fall months.

CONTROL

Poisoned-bran mash is regarded as the most effective means of controlling grasshoppers, and it is now perhaps more extensively used than any other means of control. The poisoned mash is placed around in the orchard where the insects have been working, late in the evening or early in the morning. The mash is made as follows:

Bran	pounds	50
Sodium arsenite	do	1
Low-grade molasses	gallon	1
Water	do	6

The sodium arsenite and bran are first mixed together while dry. The molasses is then dissolved in the water and added to the previously mixed dry sodium arsenite and bran and stirred thoroughly. The mixture should be used at the rate of 10 pounds (wet weight) per acre.

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[22] For further information on the treatment of the wounds and other injuries of trees, see Farmers' Bulletin 1178, "Practical Tree Surgery," by J. Franklin Collins.

[23] *Schistocerca americana* Scud.

[24] *Melanoplus femur-rubrum* DeG.

[25] *Melanoplus differentialis* Thos.

A spray of lead arsenate at the rate of 1 pound of the powder to 50 gallons of water, with the milk of lime from 3 pounds of unslaked lime, will give some protection to peach trees from grasshoppers.

As the eggs are laid in the ground, plowing or disking in the orchard, before the hatching season, will either destroy many or bury them too deep for the young nymphs to emerge. Hopperdozers are sometimes used to catch the young hoppers. The hopperdozer consists of shallow pans containing kerosene, on a frame mounted on runners or wheels, and provided with a high back and sides made of canvas. It is pulled between the tree rows, and the hoppers are killed as they hop into the pans containing kerosene.

THE PEACH-TWIG BORER

The peach-twig borer occurs throughout the southern States, but it seldom does much damage. The larva, or worm, injures the twigs and fruit of peach trees in much the same manner as does the oriental peach moth. (Figs. 15 and 16.) This has caused alarm at times when the injury from this minor peach pest has been confused with that of the oriental peach moth. Occasionally the twig injury from the peach-twig borer is rather heavy, resulting in killing or stopping the growth of shoots early in the spring.

LIFE HISTORY

The life history of the peach-twig borer is similar in some respects to that of the oriental peach moth. It passes the winter as a small larva in a silk-lined cavity under loose bark, in crotches, in cavities in the trunk, and similar places. These larvae emerge in the spring and attack the new tender shoots, which soon wilt and die. When full grown the larvae construct loosely woven cocoons on the larger limbs or trunk, in which pupation takes place. The pupal stage lasts from 8 to 12 days, when the adult moths emerge. The eggs are deposited on the new twigs or directly on the fruit, and they hatch in about 5 days. From 8 to 12 days are required for the larvae to reach maturity in midsummer. The mature larvae have a reddish-brown or chocolate color, which distinguishes them from oriental peach moth larvae, which are pink to red in color. There are four or more generations annually in the South.

CONTROL MEASURES

Spraying, just as the buds show pink, with either lime-sulphur solution at the rate of 1 part of the concentrate to 10 parts of water, or lead arsenate at the rate of 1½ pounds of powder to 50 gallons of water, has been recommended for the control of the peach-twig borer. The clipping and burning of infested twigs during the summer and the burning of brush removed during the winter pruning will lessen injury from this insect.

THE CORN-EAR WORM

The corn-ear worm occurs throughout the South and is primarily a pest of corn, tomatoes, tobacco, cotton, and legumes. On vetch and other legumes it feeds in colonies, and when these crops are not turned under early enough, are left for seed, or are cut late, the worms assume the army-worm habit and move in "armies" to adjacent peach orchards or fields of other crops. Because of this habit corn-ear worms are sometimes confused with army worms. In 1926 corn-ear worms did considerable damage to peaches and other crops in Georgia, Alabama, and South Carolina. Considerable vetch was grown in the South that year, and peach orchards adjoining fields in which vetch was not turned under soon enough or allowed to go to seed were materially damaged by the worms devouring the green peaches as they marched across them. The damage occurred from the middle of May to the first part of June. In one orchard in southern Georgia the corn-ear worms practically destroyed the crop of peaches on 4,000 young trees. In this case vetch had been planted between the tree rows and the grower had failed to turn it under early enough. In another case the worms attacked a peach orchard from hay in a near-by barn, where they had hatched after the hay was cut and stored.

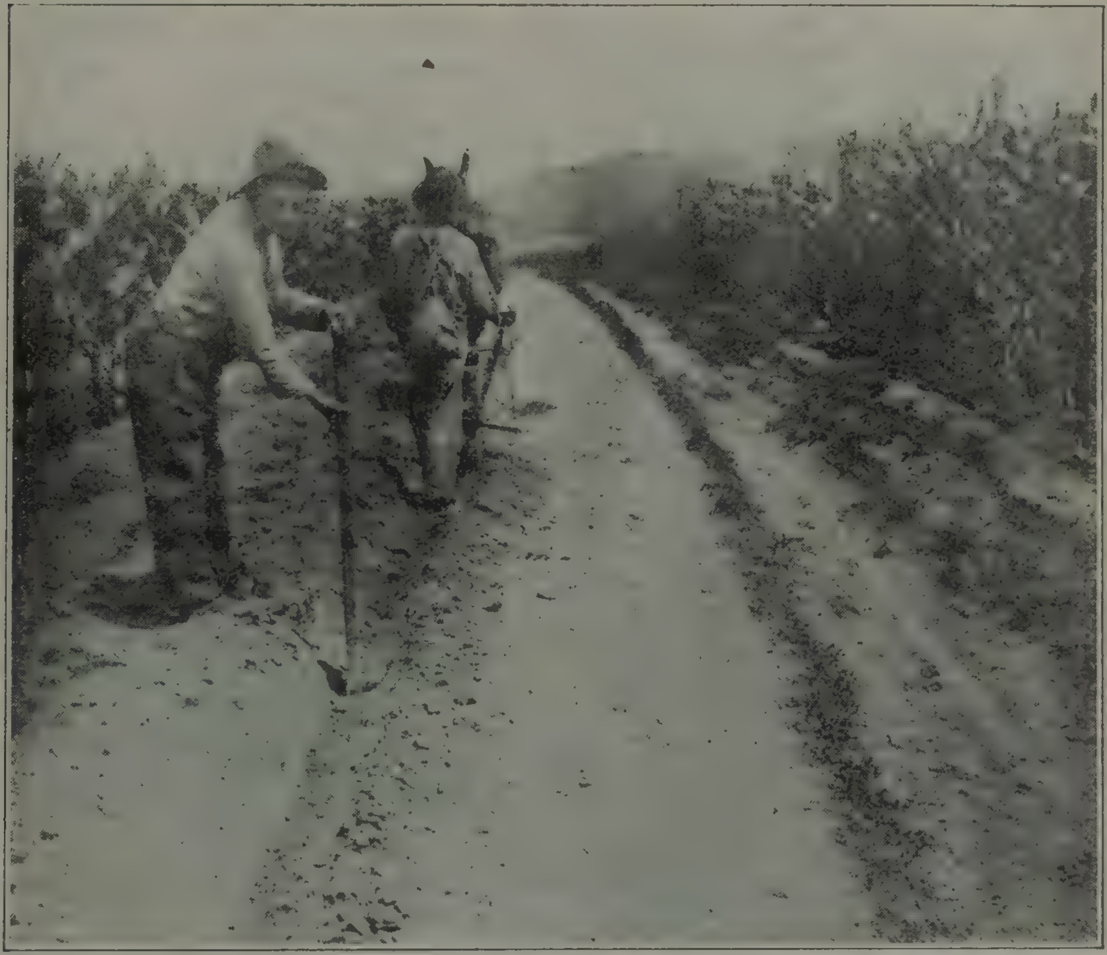

FIG. 20.—Furrow in cornfield to protect it from the corn-ear worm. This is the kind of furrow that should be used in protecting peach orchards. Note posthole to trap the worms. (Luginbill and Beyer)

The entire life cycle of this insect requires 35 or 40 days during the summer months. Only larvae, or worms, of the first generation attack green peaches in the South. These hatch during May and June. There are four generations annually in the South.

CONTROL MEASURES

When the insect assumes the army-worm habit and starts marching from vetch fields toward peach orchards it can best be prevented from injuring the peaches by constructing a deep furrow around the orchard or in the path of the advance of the worms. (Fig. 20.) This furrow can be made with a turn plow or ditching machine. One side should be steep, and postholes should be provided at intervals to entrap the worms. (Fig. 20.) This method of protecting peach orchards that are threatened by the insect has been used successfully in Georgia. Poisoned-bran bait, such as described for use in grasshopper control, broadcasted in the orchard, or spraying or dusting with lead arsenate, is recommended after the worms get into an orchard. The lead arsenate should be used at the rate recommended for the control of the plum curculio.

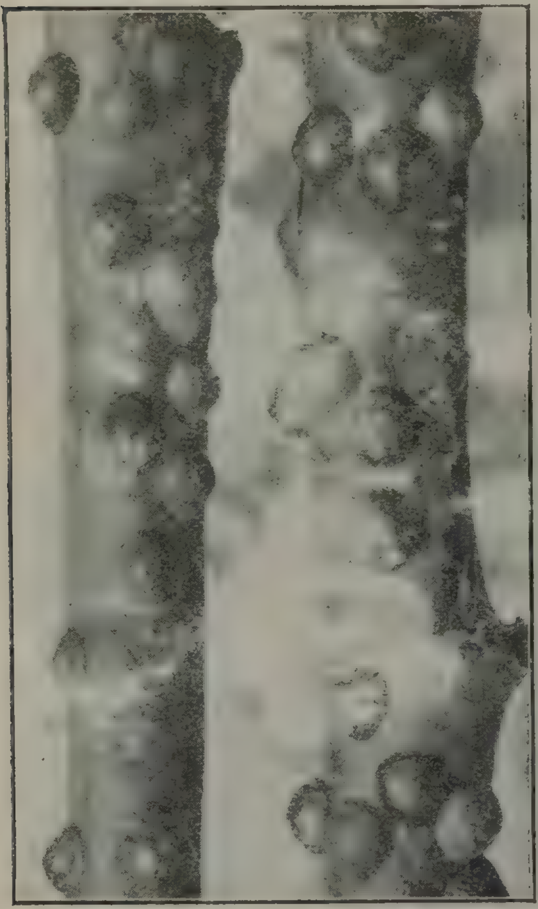

FIG. 21.—The terrapin scale on peach twigs. About twice natural size. (Quaintance and Siegler)

THE TERRAPIN SCALE AND WEST INDIAN PEACH SCALE

The terrapin scale or peach lecanium (fig. 21) has been found on fruit trees in each of the Southern States, although it is seldom a pest of major importance. Its presence is indicated by the sooty condition of the twigs and leaves caused by a fungous growth on the honeydew excreted by the insect. This sooty fungus renders the fruit unmerchantable. The insect injures the tree in a manner similar to that of the San Jose scale, although it seldom directly causes the death of the tree. The scale covering resembles somewhat the shell of a terrapin; it varies in color from black to red and has a somewhat ridged edge.

The West Indian peach scale, or white peach scale as it is sometimes called, has been found in a number of localities in the South, and, as a peach-tree pest, it is sometimes as injurious as the San Jose scale. Some years ago the West Indian peach scale caused considerable injury to peach trees in the vicinity of Natchez, Miss. The females are circular and of a brownish-white color. The males, which usually occur in clusters, are elongated and pure white. There are four or five generations annually in the South.

CONTROL MEASURES

Lubricating-oil emulsion, 12 gallons of the stock solution to 188 gallons of water, applied as recommended for the control of the

San Jose scale, is recommended for the control of the terrapin scale. A 3 per cent strength of oil will doubtless be effective against the West Indian peach scale. The emulsion should be applied during the winter, while the trees are dormant. Lime-sulphur has been used successfully against the West Indian peach scale, but it is apparently ineffective against the terrapin scale.

SQUASH BUGS

Several species of the squash-bug family have been known to attack peaches in the South, and in some instances they have caused considerable damage. The species most commonly found attacking peaches is known scientifically as *Leptoglossus oppositus* Say. These insects pierce the green peaches with their beaks and then suck out the sap for food. They have been found with the beak inserted into a peach to a depth of one-half inch. This feeding early in the season causes the fruit to become knotty and ill-shaped by harvest. (Fig. 22.) The attacks on peaches are usually made by adults, but nymphs, or young bugs, also have been found feeding on them. This insect passes the winter as an adult. There are several generations annually.

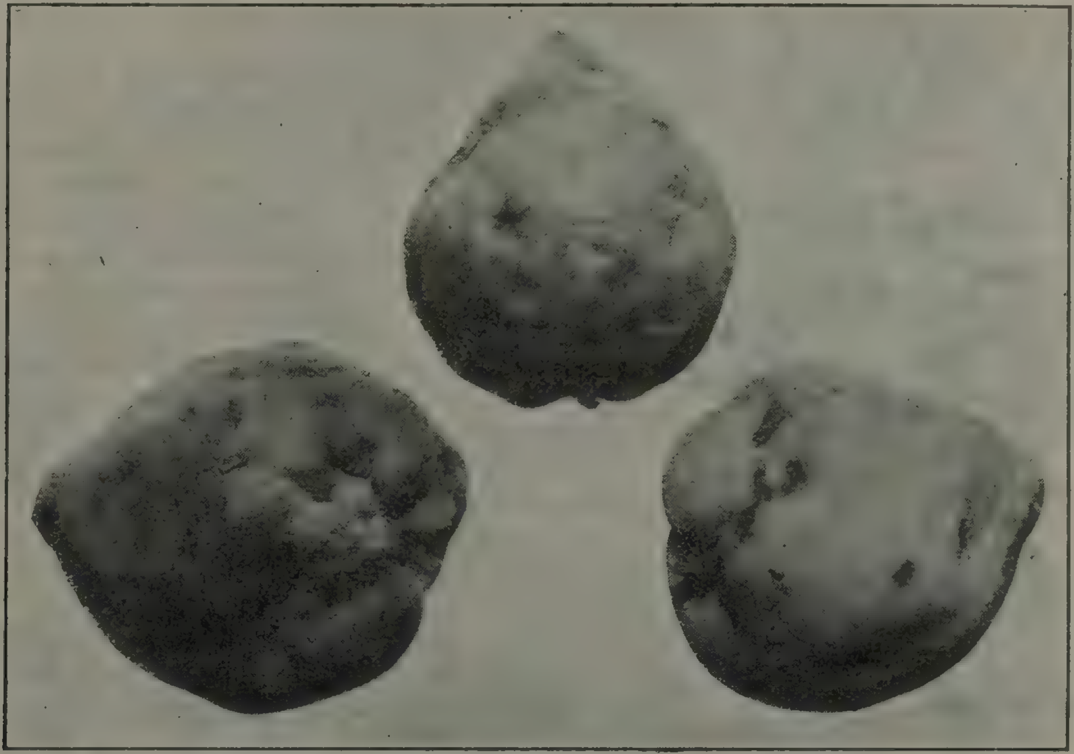

FIG. 22.—Ripe Hiley peaches showing effect of attacks by a member of the squash-bug family, *Leptoglossus oppositus*, several months before

CONTROL

Hand picking is the most satisfactory means of control. Nicotine-sulphate spray at the rate of 1 pint to 50 gallons of water with a little laundry soap will control the nymphs, or young bugs, but will not kill the adults. The adults can be trapped under boards or stones placed close to where the insects are working.

SOUTHERN GREEN PLANT BUGS

Southern green plant bugs are also known as stinkbugs or pumpkin bugs. They can be easily recognized by their odor. Injury to peaches in the South sometimes results from these bugs sucking the sap out of the fruit from shortly after it sets until it ripens. When southern green plant bugs attack green peaches that are half grown or less, the ripening fruit will often be gnarly or knotty, much as is that attacked by members of the squash-bug family. When the infestation is heavy, nymphs, or young bugs, of all sizes may also be found attacking peaches. This insect passes the winter in the adult stage. There are several generations annually, which may overlap.

CONTROL

Climatic conditions and parasites usually hold the southern green plant bug in check. It usually occurs in injurious numbers only after mild winters, and since it is attacked by several parasites its occurrence as a fruit pest is only occasional. No spray has yet been developed that can be used efficiently against the adults. Nicotine sulphate at the rate of 1 pint to 50 gallons of water with soap is fairly effective against the young bugs or nymphs.

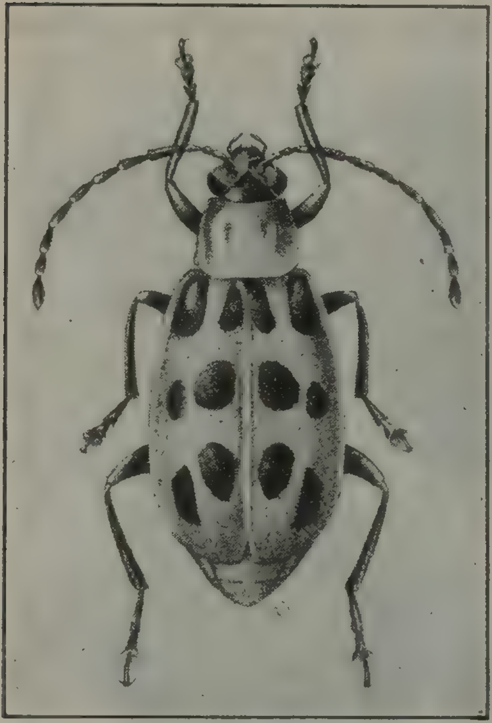
FIG. 23.—The spotted cucumber beetle. About seven times natural size

THE SPOTTED CUCUMBER BEETLE

The spotted cucumber beetle (fig. 23) is sometimes an injurious pest in southern peach orchards. By the time peach trees are in full bloom in the spring these beetles are out in numbers and begin feeding on the calyxes of the peach flowers, in many cases eating through them and devouring the little peaches which have just set. Orchards near cornfields and gardens are especially subject to attacks from these insects. The beetles may also feed on the tender leaves of nonbearing peach trees during the spring and early summer. Attacks in nonbearing orchards have been known to be severe enough to warrant the use of control measures.

LIFE HISTORY

The spotted cucumber beetles pass the winter in the adult stage, hibernating in grass and other vegetation in and near the orchards. They usually make their appearance in Georgia during March, when they attack the peach flowers, devouring the calyxes and little peaches. Egg deposition starts in April. The eggs are laid just under the surface of the soil. The incubation period varies from about two weeks early in the season to less than one week later on.

Within a month the larvae become full grown and pupate. Adults of the first generation make their appearance in the South during May and June. There are several generations annually.

CONTROL

Lead arsenate, as used for the control of the plum curculio, apparently either repels the spotted cucumber beetles on peach trees or kills many when they feed upon the poisoned flowers and foliage. Application of lead arsenate in the proportion of 1 pound of the powder to 50 gallons of water, with the milk of lime from slaking 3 pounds of stone lime, or from 4 pounds of hydrated lime, has proved effective in stopping attacks by this insect on bearing peach trees. This treatment is also effective against the insect attacking tender foliage of nonbearing peach trees.

BLISTER BEETLES

Blister beetles are primarily pests of vegetables. However, one species[26] attacks the foliage and blossoms of peach trees. These beetles are slender in form, about one-half inch long and three-sixteenths inch wide, rather soft bodied, and varying in color from brown or bronze to a metallic green. They are greedy feeders, traveling in the army-worm manner, or in swarms, eating almost every kind of vegetation. When they get into a peach orchard they strip the trees of foliage and blossoms. A large swarm of blister beetles has been known to devour all of the blossoms and foliage on 50 trees in a Georgia peach orchard. This injury occurred about the middle of March.

CONTROL

For the control of blister beetles on peach trees, lead arsenate at the rate of 1 pound of the powder to 50 gallons of water, with the milk of lime from 3 pounds of unslaked lime, is recommended. This treatment, combined with jarring the insects on to a sheet, has been used successfully in Georgia, checking a severe outbreak within two days.

THE TARNISHED PLANT BUG

Peach nursery stock in the South is sometimes attacked by the tarnished plant bug, which punctures the terminal buds and tender growing tips in sucking out the plant juices for food. This causes the terminal buds and tips to turn brown, wither, and die, and the tree then develops a bushy form. Injury to peach nursery stock by this insect may easily be confused with that caused by the oriental peach moth.

No satisfactory control for this insect on peach nursery stock has been found. Peach-tree nurseries and surrounding areas should be kept free from weeds, as certain weeds harbor this insect.

THE GREEN JUNE BEETLE

The green June beetle, commonly known as the "June bug," is sometimes troublesome in southern peach orchards. It may appear in large numbers about the time that the fruit is ready to be harvested, when it cuts through the skin and feeds on the inside.

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[26] *Pomphopoea aenea* Say.

As this beetle usually does not become troublesome until the fruit starts to ripen, poisonous sprays can not be employed as a means of control. Continuous hand picking of the beetles is recommended as a protection to the peach crop, and manure piles should not be allowed to remain near an orchard, as they offer excellent breeding conditions for the insect.

THE RUSTY-BROWN PLUM APHID

The rusty-brown plum aphids occur in all of the Southern States, and are present each year, doing more or less damage to the foliage of plum and young peach trees shortly after they put forth leaves. They are more common in home orchards that are not sprayed for other pests in the spring of the year. In central Georgia they usually damage plum and peach foliage from March to May. This louse is of a dark rusty-brown color. It occurs in great numbers and causes the new foliage to become distorted and crumpled by sucking out the food material. The pest may cause the terminal buds of the plum and young peach trees to become so stunted that growth ceases. A heavy infestation may kill the blossoms and prevent fruit from setting.

LIFE HISTORY

The eggs, which were deposited on the small twigs the previous fall, begin to hatch about the time the buds open. The first generation are all wingless females, or stem mothers, which give birth to living young that develop into wingless females. The first several broods are wingless, but later winged forms are produced that migrate to several varieties of grasses and there breed during the remainder of the summer. As cold weather approaches in the fall, winged forms return to the plum and young peach trees and produce wingless females, which are almost black, and these deposit the winter eggs on small limbs.

CONTROL

As soon as the insect appears, spray with nicotine sulphate at the rate of three-fourths of a pint to 100 gallons of water, adding 3 pounds of soap, or a little casein-lime emulsifier, to each 100 gallons of spray to make it stick and spread better. This spray will not be fully effective if the application is delayed until after the leaves curl badly. It is said that lime-sulphur, as used during the winter for the San Jose scale, will destroy the eggs of the rusty-brown plum aphid.

SPRAYING AND DUSTING OUTFITS

For spraying a few peach trees around the home, or in a small home orchard, a bucket spray pump may be used. This should be made of brass or some other metal that will not corrode. A good type of bucket spray pump is shown in Figure 24; however, this should be equipped with a 4-foot extension rod and at least 15 feet of hose.

For spraying orchards of up to 400 or 500 trees, a barrel spray pump (fig. 25) will be found satisfactory. This fits into a 50-gallon barrel and develops 125 to 150 pounds pressure. It should be equipped with a 4-foot extension rod and at least 25 feet of hose.

The double-acting hand spray pump, which will develop from 150 to 200 pounds pressure, is sometimes used in peach orchards of 5 to 10 acres. This is more costly than the barrel outfit, but much cheaper than a power sprayer. It will develop sufficient pressure for two leads of hose. The chief objections to this outfit are the man power required to operate it and the lack of proper agitation.

The power spray outfit (see title-page) is the most satisfactory, useful, and convenient type of sprayer. It may be purchased in various sizes, and should be used in peach orchards of 10 acres or over. It will develop from 150 to 300 pounds pressure, depending on the power of the motor, and will deliver from 5 to 15 gallons of spray per minute. It is usually equipped with a 200-gallon spray tank, and two leads of hose 35 feet long should be provided.

For dusting a few peach trees a hand duster, consisting of a cylinder with piston rod for making an air blast, may be used. Larger hand dusters in which a fan is operated by cogs or belt from a crank will be found more satisfactory and durable for dusting a few trees or a very small home orchard by hand.

For dusting commercial or large home orchards a power duster outfit (fig. 26) should be employed. These outfits are driven by a 3 or 4 horse-power gasoline engine, and can be regulated so as to discharge the desired quantity of dust.

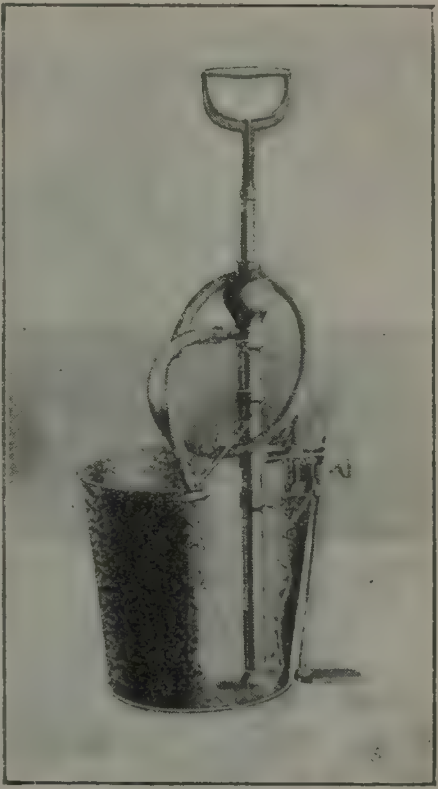

FIG. 24.—Bucket pump for spraying a few peach trees. This outfit should be equipped with a 4-foot extension rod and at least 15 feet of hose. (Quaintance and Siegler)

INSECTICIDES

LEAD ARSENATE

Lead arsenate is the standard insecticide for chewing insects. It may be purchased in either the powder or paste form, but the powder is preferred. In this bulletin it is recommended for the control of the curculio, grasshoppers, peach-twig borer, corn-ear worm, spotted cucumber beetle, and blister beetles. On peach trees, powdered lead arsenate is used at the rate of 1 pound of the powder to 50 gallons of water, with the milk of lime from slaking 3 pounds of unslaked lime or from 4 pounds of hydrated lime. The milk of lime is used to reduce burning by the lead arsenate. Powdered lead arsenate should be made into a thin paste with water before adding to the spray barrel or tank containing the required quantity of water.

NICOTINE SULPHATE

Nicotine sulphate is the standard insecticide for sucking insects. Commercial nicotine sulphate, containing 40 per cent of nicotine, is available on the market. When used alone, soap or a casein-lime emulsifier should be added in order to make it spread and stick. In this bulletin nicotine sulphate is recommended for the control of southern green plant bugs and the rusty-brown plum aphid. On peach trees it is generally used at the rate of one-half pint to 50 gallons of water, with 1½ pounds of soap or 6 ounces of a casein-lime mixture.

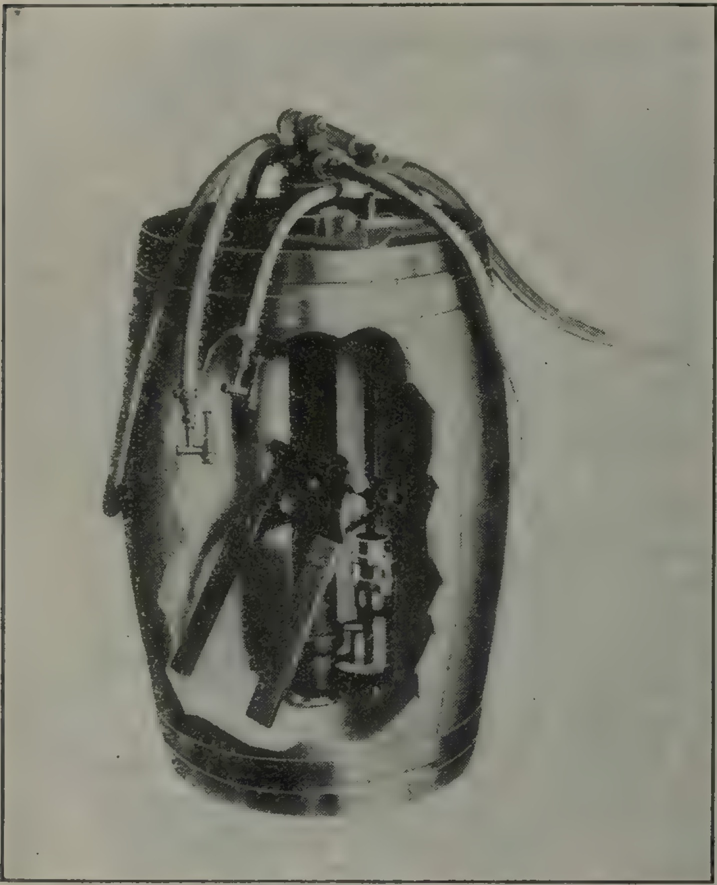

FIG. 25.—Barrel spray pump for orchards up to 5 acres. This outfit should be equipped with a 4-foot extension rod and 25 feet of hose. (Quaintance and Siegler)

LUBRICATING-OIL EMULSION

Lubricating-oil emulsion is recommended for the control of the San Jose, terrapin, and West Indian peach scales. The concentrated stock emulsion can be purchased from manufacturers, or can be made according to directions given on pages 21 and 22. The stock emulsion should contain approximately 66⅔ per cent of oil. This should be diluted in the proportion of 9 gallons to 191 gallons of water for use on peach trees during the dormant season for the control of the above-named scale insects.

LIME-SULPHUR SOLUTION

Lime-sulphur solution is an old remedy for the San Jose scale. It is also recommended in this bulletin for the control of the West Indian peach scale, peach-twig borer, and rusty-brown aphid. The solution can be purchased from manufacturers, or it can be made on the farm as explained in Farmers' Bulletin No. 1285.[27] The concentrate should test 32° or 33° Baumé, and should be used at the rate of 1 part to 7 parts of water for scale control and at the rate of 1 to 10 for peach-twig borer control.

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[27] SIEGLER, E. H., and DANIELS, A. M. See footnote 21.

POISONED-BRAN MASH

Poisoned-bran mash is used for the control of grasshoppers and the corn-ear worm. It should be placed in the orchard late in the evening or early in the morning at places where the insects have been working. Directions for preparing poisoned-bran mash are given on page 31.

PARADICHLOROBENZENE

Paradichlorobenzene is recommended for the control of the peach borer. It has also been suggested for the oriental peach moth. This crystalline material of about the fineness of granulated sugar can be purchased readily on the market. For peach trees 4 and 5 years of age it should be used at the rate of three-fourths ounce per tree, and for trees 6 years of age and older the 1-ounce dose should be used (see page 13).

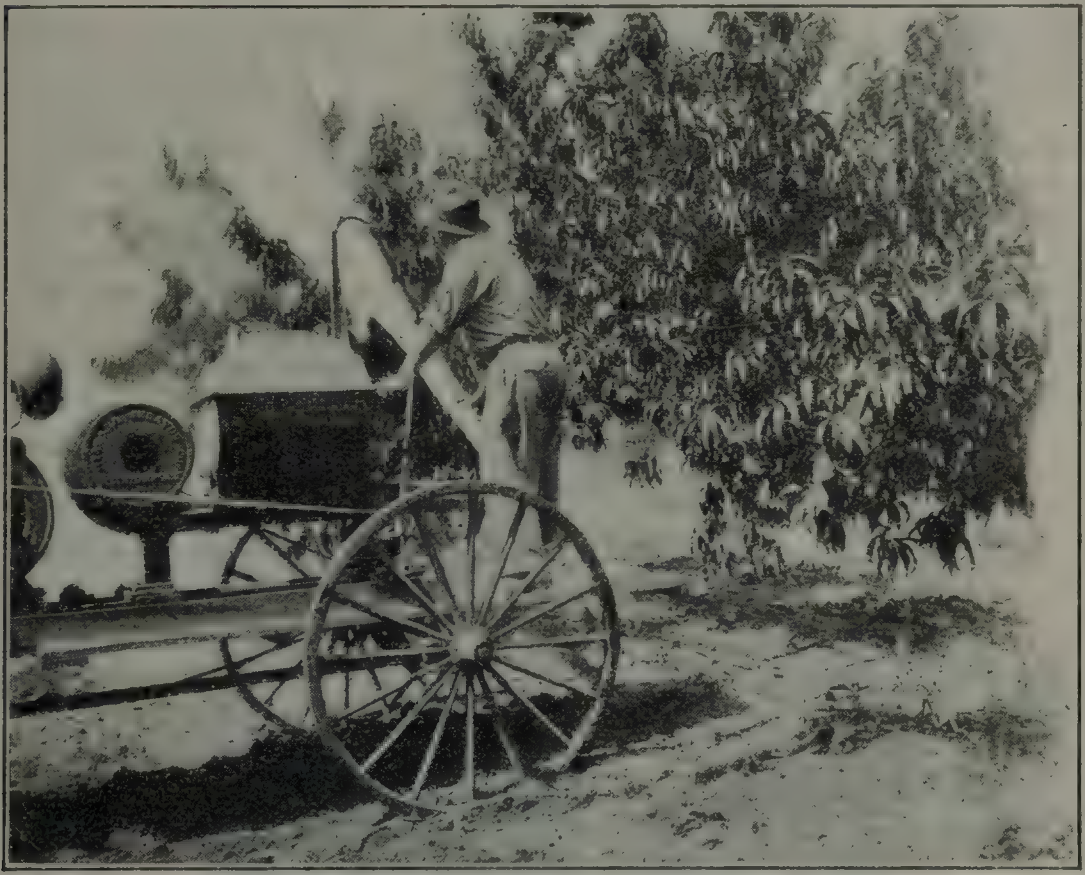

FIG. 26.—Power dusting machine for large home and commercial orchards

DUSTING MATERIAL

Dusts containing powdered lead arsenate are recommended for the control of the curculio and may be used for the control of other chewing insects. The mixture should contain 5 per cent of powdered lead arsenate, the remaining 95 per cent being made up of hydrated lime or of sulphur and hydrated lime (see p. 7). Where heavy infestations of chewing insects are to be controlled, the liquid spray may prove to be a little more effective than the dust.

BENEFICIAL INSECTS

There are several insects that assist materially in checking the multiplication of injurious peach insects. Ladybird beetles are perhaps the most beneficial to the peach grower. They prey upon scale insects, aphids, and thrips. The twice-stabbed ladybird beetle is usually prevalent on peach trees that are heavily infested with the San Jose scale. It is jet black in color and has two orange or red spots on the back. Ladybird beetles take their nourishment by sucking scale insects dry. They also assist materially in checking infestations of the rusty-brown plum aphid or other aphids. The adult and young ladybird beetles are sometimes erroneously thought to be the parents of aphids, on account of their close relation with these pests. Peach growers should encourage the multiplication of twice-stabbed and other ladybird beetles.

Syrphus flies, lace-wing flies, tachina flies, ground beetles, and some of the assassin bugs and praying mantids are other insects that are beneficial to the peach grower. Predacious and parasitic insects give considerable aid in controlling peach insects, and without the help of these beneficial insects it would be very difficult to grow a crop of peaches, even though artificial control measures were enforced.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No.1558

PREPARATION OF EASTERN GRAPES *for* MARKET

EASTERN GRAPES which were formerly sold for table stock have been largely diverted from that market. The greater ease in meeting the comparatively low packing requirements for juice stock has reacted unfavorably upon general packing and handling practices, with the result that comparatively few growers have been attempting to meet the demands of the fancy table-grape trade.

The enormous expansion of the grape industry, however, particularly in California, has resulted in such keen competition in the marketing of juice grapes that the growers of eastern grapes are turning with renewed interest to the development of their table-stock trade.

This bulletin describes the harvesting, packing, and handling of eastern grapes for market. These methods have been employed with success by commercial growers in the various important producing sections.

Washington, D. C. **Issued March, 1928**

PREPARATION OF EASTERN GRAPES FOR MARKET

By B. E. **Shaffer**, *formerly Investigator in Marketing, Bureau of Agricultural Economics*

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LEADING PRODUCING SECTIONS

EASTERN-TYPE grapes are produced commercially in at least seven States, but by far the greatest concentration is found in the Chautauqua and Finger Lakes areas of New York, the Benton Harbor and Paw Paw districts of southwestern Michigan, and in Erie County, Pa. Arkansas has a large new acreage in the vicinity of Springdale in the northwestern part of the State and ranks fourth in order of importance as a shipping State although still far below Pennsylvania. Figure 1 shows the location of the chief grape-shipping districts, and Table 1 gives an approximate idea of their relative importance, although each year an increasingly large volume is shipped from the eastern districts by motor truck.

For purposes of comparison the carload-shipment figures from California are also given, although grape production in that State is confined almost exclusively to the Vinifera or European varieties. It is probable that a greater proportion of the California commercial crop is moved in carloads than is the case in the eastern districts where there is an extensive truck movement.[1]

TABLE 1.—*Carload shipments of grapes, by States of origin, 1926*

State	Shipments	State	Shipments
	Cars		*Cars*
California	63,549	Ohio	101
New York	7,002	Delaware	89
Michigan	3,012	Kansas	69
Pennsylvania	1,355	Arizona	63
Arkansas	1,200	All other	104
Missouri	759	Total	77,585
Iowa	161		
Washington	121		

COMMERCIAL VARIETIES

The leading commercial varieties of the eastern type are Concord, Niagara, Catawba, Delaware, Moore, Worden, and Champion. Of

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[1] ALEMAN, DUDLEY. MARKETING EASTERN GRAPES. U. S. Dept. Agr., Dept. Bul. 861, 61 pp., illus., 1920.

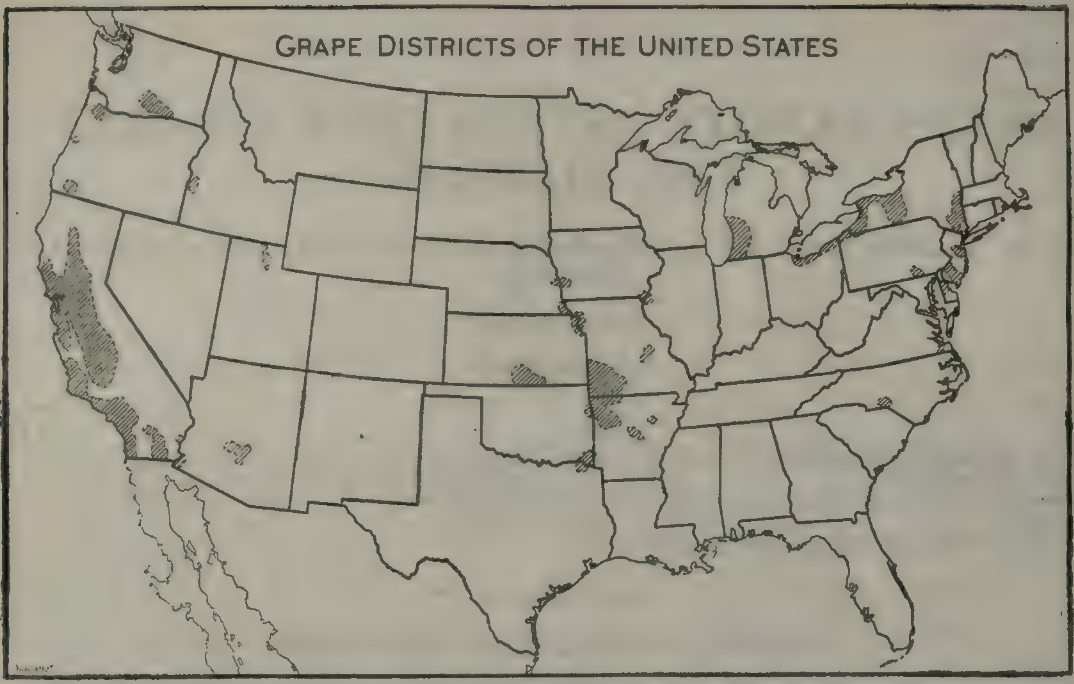


FIG. 1.—The grapes grown in California and Arizona are almost entirely of the Vinifera or European type. Native American grapes are grown in the other important districts shown. A large percentage of the crops of Michigan, New York, Pennsylvania, New Jersey, and Delaware are moved by auto truck

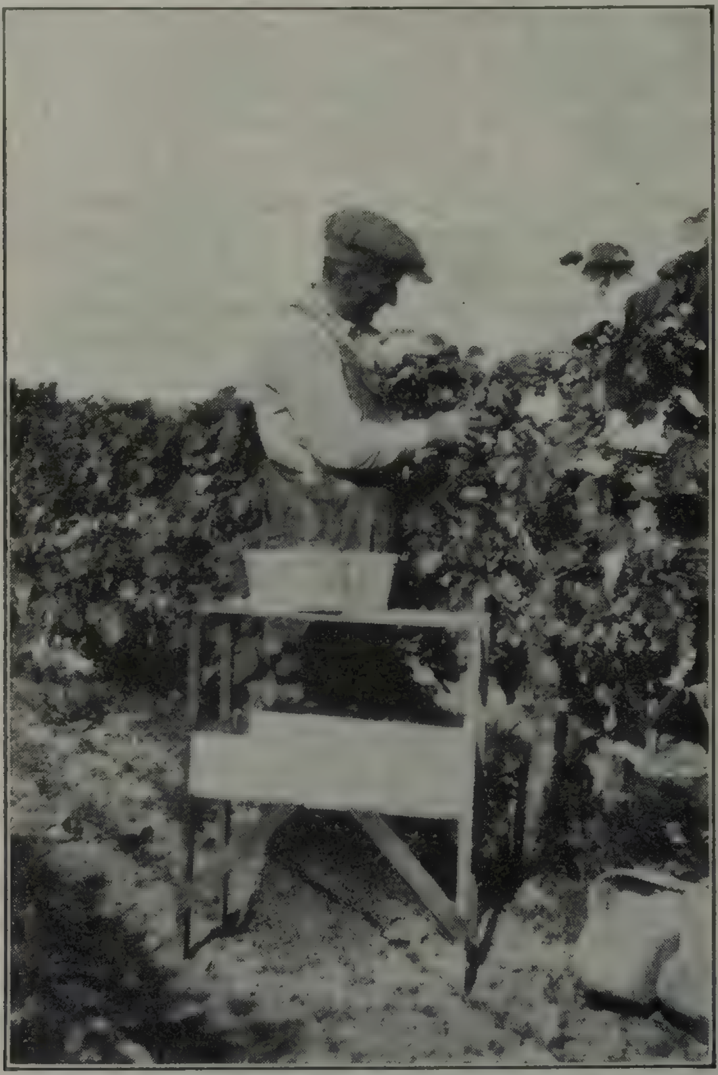


FIG. 2.—Picking grapes. Note type of picking bench used and method of cutting bunches of grapes

these the Concord is most important. A few wine grapes such as Ives and Elvira are grown to a very limited extent in the central lake district of New York. Other varieties of eastern grapes find their way into trade channels, but their production is not commercially important.

HARVESTING AND PACKING

TIME OF PICKING

The proper stage of maturity for picking grapes may be judged with sufficient accuracy for commercial purpose by the color and taste. When the grapes have attained full color for their variety and have developed enough sugar to be palatable they are ready to harvest.

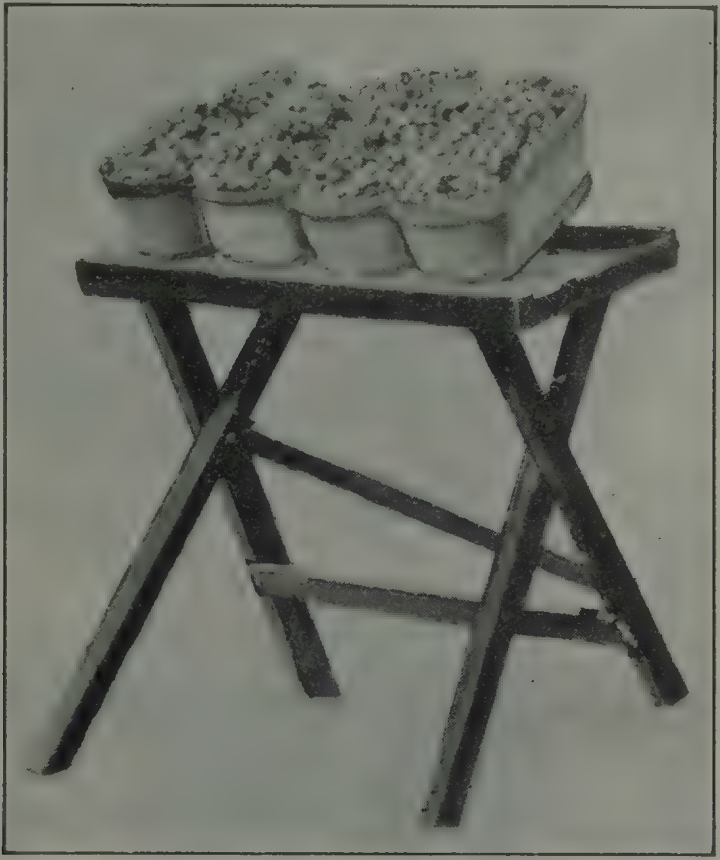


Fig. 3.—A common type of picking bench. Note long top, allowing room for four 4-quart baskets

No physical test capable of giving more reliable results has been developed. The use of the hydrometer in connection with what is popularly called the "sugar test," but which actually shows the percentage of solids in the juice, is common in California in connection with the enforcement of maturity standards for European varieties, but, depending upon climatic conditions, eastern-type grapes of the same variety and approximately the same degree of maturity may show a variation of several degrees in hydrometer readings.

PICKING

The operation of picking must be performed with great care, especially where a fancy table-grape pack is being put up. The bunches are easily crushed and bruised by rough handling, and damp berries are soon followed by mold and decay, especially in warm weather. Shears or clippers are used to cut the clusters from the vines. Ordinarily the grapes are placed directly in the Climax baskets which are the usual shipping containers. The fancy packs are placed in the 2-quart and 4-quart baskets. For the lower grades the 12-quart size is used. (Fig. 2.)

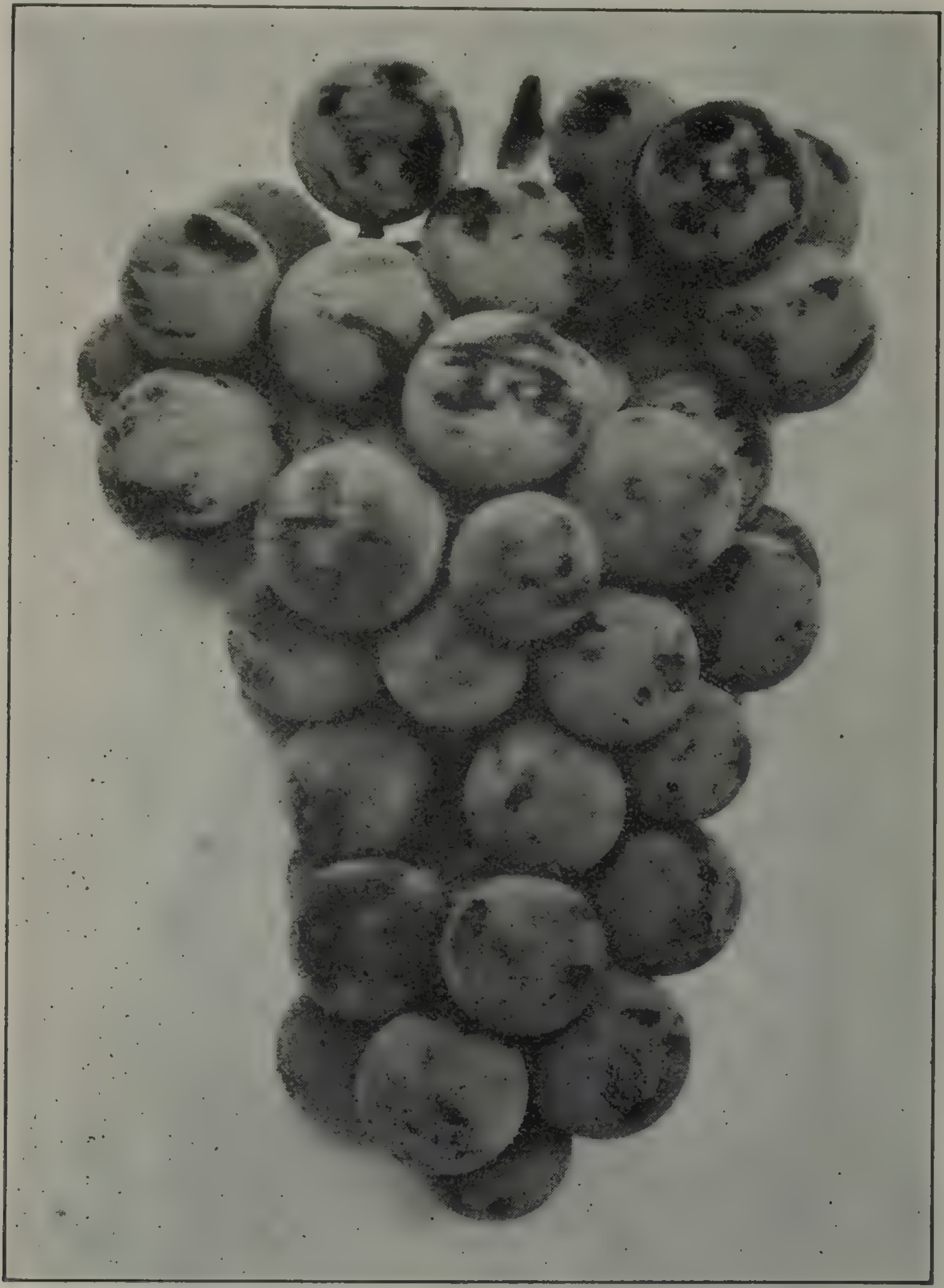


FIG. 4.—Quality of stock desired in the highest grade

Field benches are used for picking and packing. These benches are usually made by the growers, although a few commercially manufactured benches are in use in the New York and Pennsylvania districts.

A well-designed bench should be rigidly constructed of light material with the legs spread far enough apart to insure steadiness on the soft and more or less uneven ground in the vineyard. Thirty inches is about the right height. The top should be about 16 inches wide and long enough to hold at least three baskets.

PACKING

Eastern grapes are usually packed in the vineyard. The best type of bench for the purpose is shown in Figure 3. It accommodates four baskets, and the sloping position in which they are held facilitates packing. This arrangement permits packing three grades, with an extra basket for the culls. Typical U. S. Fancy, U. S. No. 1, and No. 2 bunches are shown in Figures 4, 5, and 6. Such grading is practicable only where the vineyard run is of good quality and the grapes are plentiful. In seasons of poor yields the picker seldom uses a stand or carries more than one basket. Proper grading under such circumstances is practically out of the question.

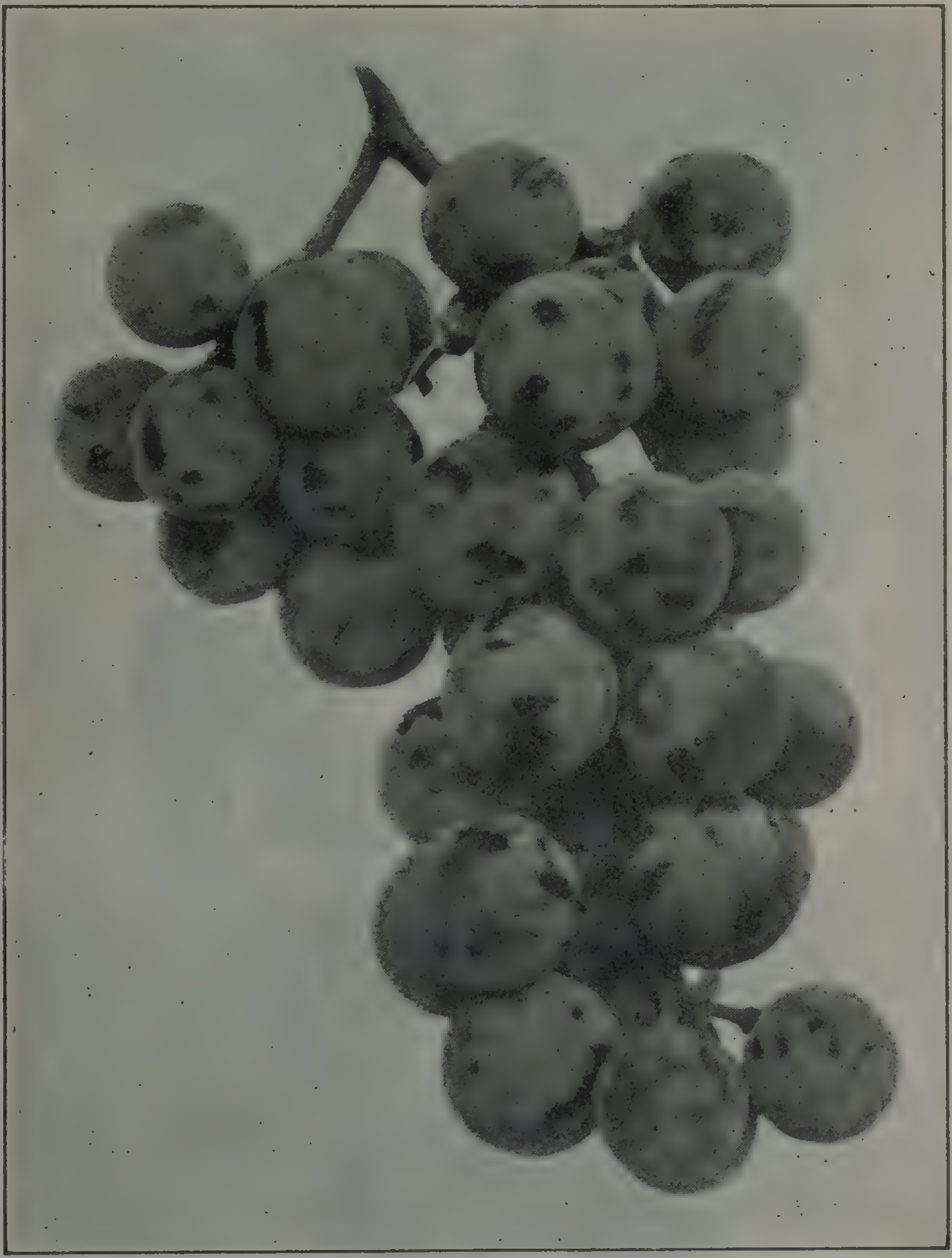


FIG. 5.—Quality of stock to be expected in a good average grade

To start the pack properly the lower end of the basket should be filled first, as shown in Figure 7. The package is then filled carefully and snugly to a height of about 1 inch above the top of the basket, and the top of the grapes should be level, as shown in Figure 8. All stems should be concealed, and openings between the large bunches should be filled with smaller bunches. This method results in a full pack without danger of crushing the berries. The lids should not be put on until the stems wilt, for the wilting permits the bunches

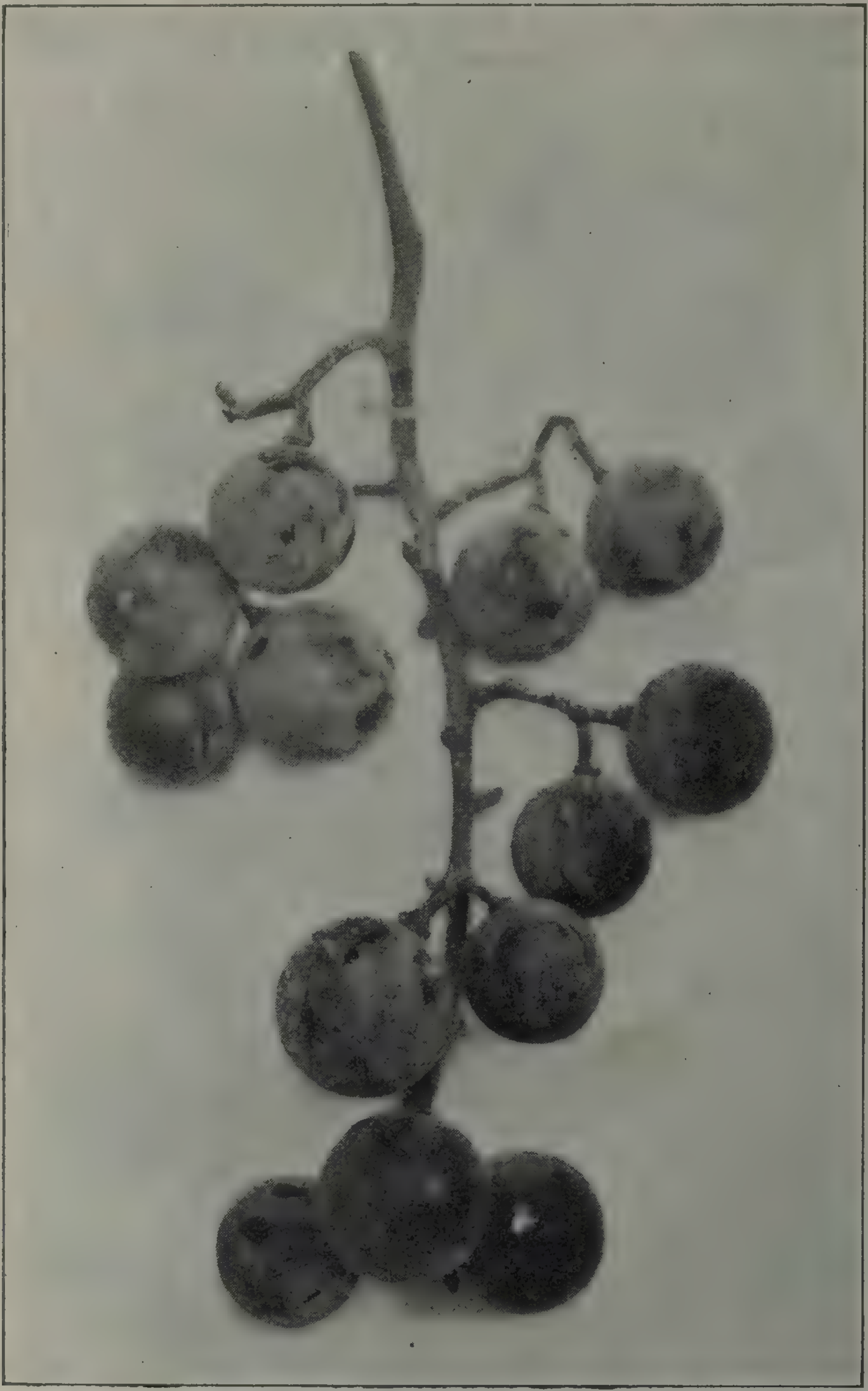


FIG. 6.—Quality of stock usually found in the lowest grade of eastern grapes. Such stock should not be packed for table use

to settle. The best vineyard packers remove the baskets from the vineyards on flat-topped wagons that hold but a single layer of baskets. After sufficient time has elapsed to permit the wilting of the stems the packs are inspected, slack packages are filled, and the lids are adjusted.

Some growers erect a temporary structure protected by a board or canvas roof and equipped with flat-topped tables, where the inspection and lidding are carried on.

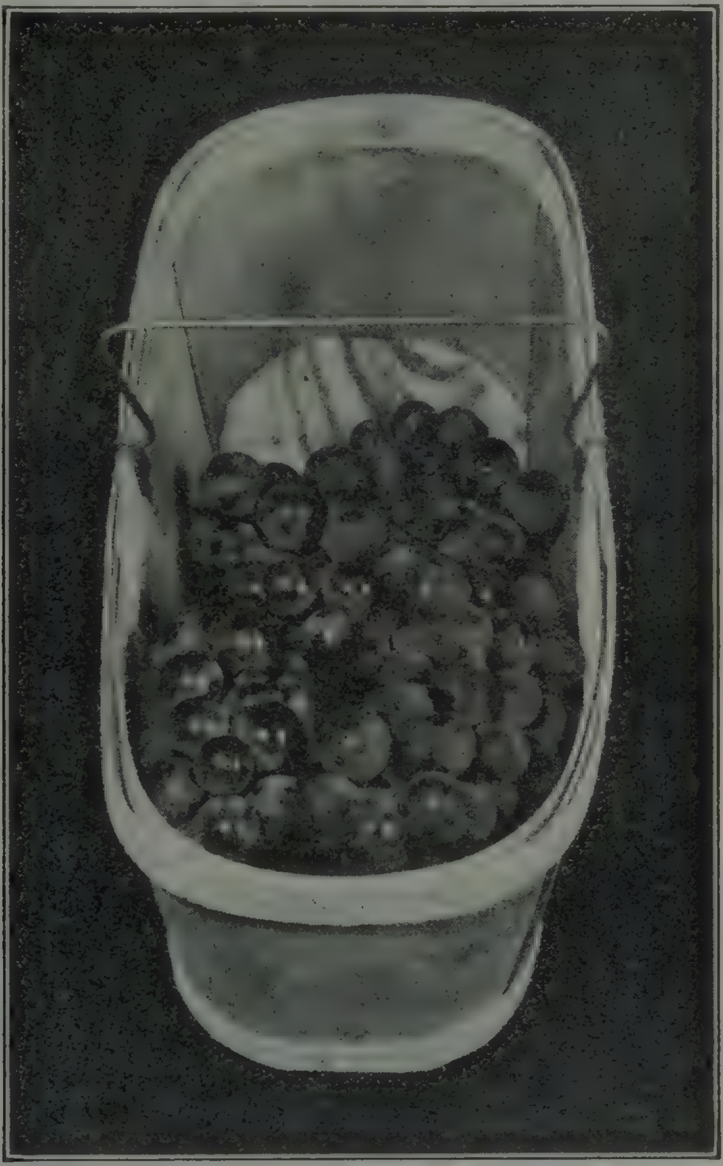


FIG. 7.—To pack a basket properly first fill the lower end of the tilted basket, finishing the top evenly, with all stems concealed as the packing operation is completed

Every effort should be made to avoid the necessity of repacking, as each time the bunches are handled there is danger of bruising and cracking the berries and of disturbing the characteristic attractive bloom. Crushing is certain to result if the bunches project too far above the top, as in Figure 9, and in hot weather such crushing frequently results in the development of mold within a few hours. During such periods it is highly important to place the fruit under refrigeration as soon as possible after packing. Grapes should be

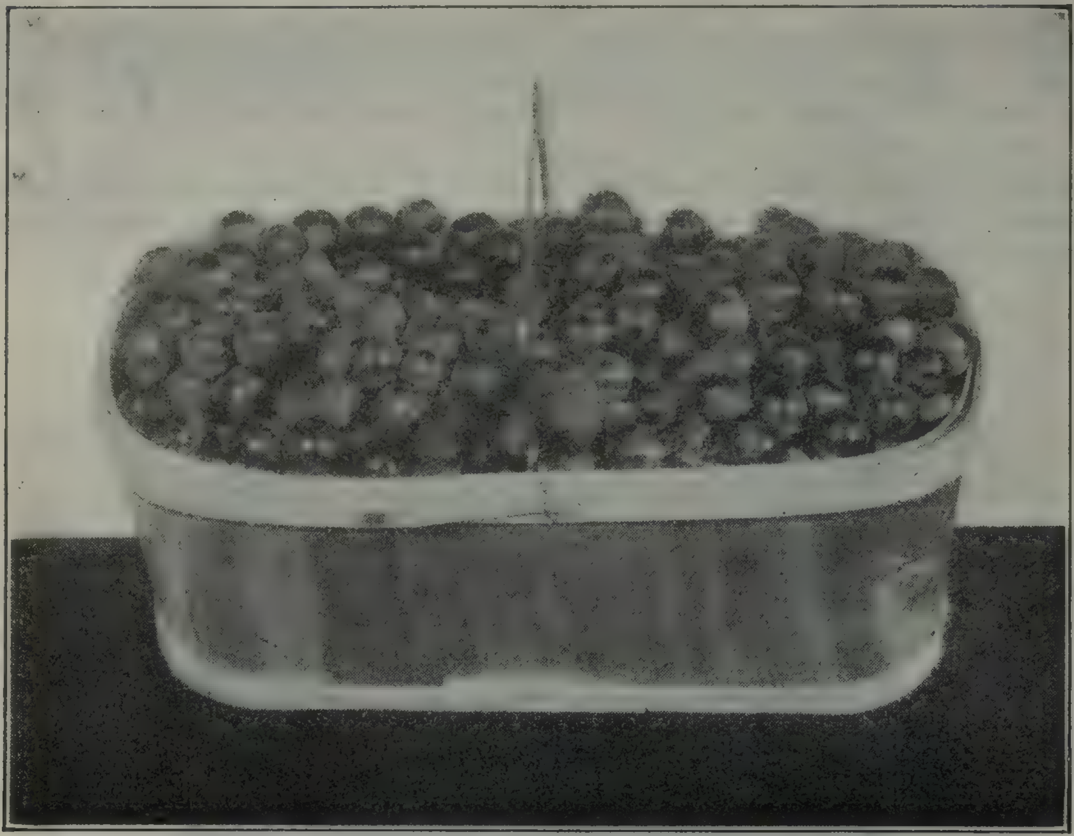


FIG. 8.—A properly packed basket, showing even surface

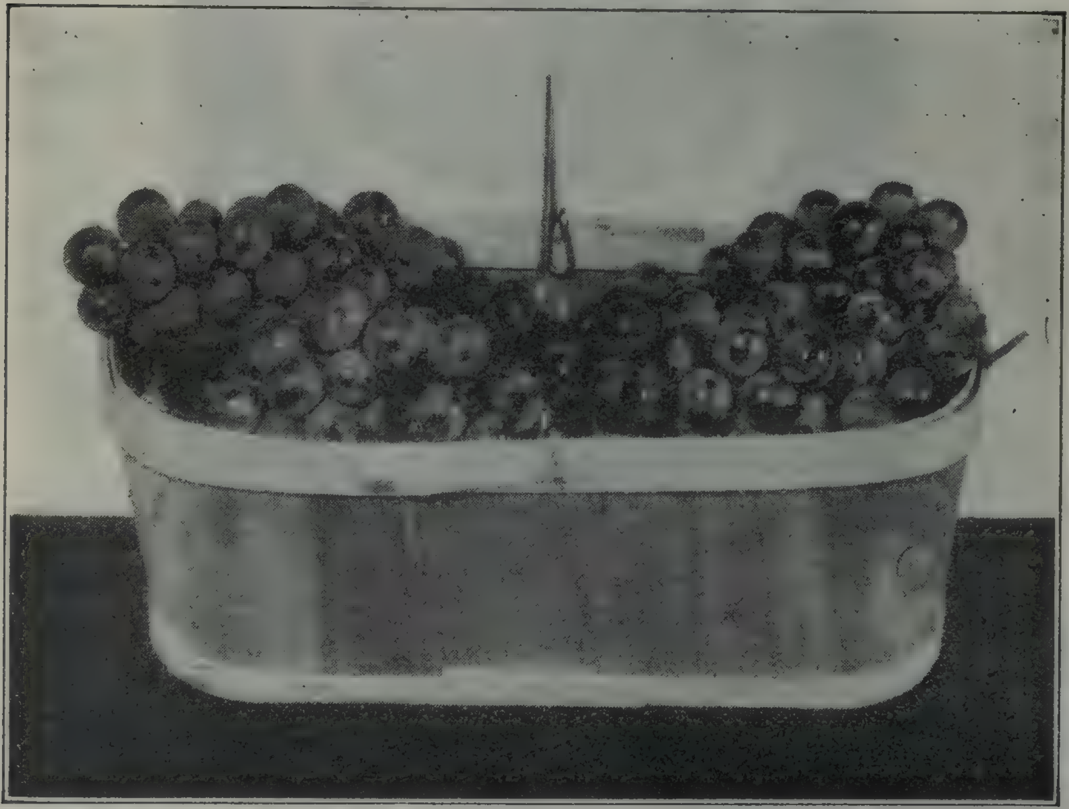


FIG. 9.—Improperly packed basket. When covers are placed on a basket packed in this way many berries are bruised and considerable decay often results

picked with great care and placed with the stems up in field boxes of the type shown in Figures 10, 11, and 12. If the grapes are handled in this way, the marketing season may be extended from three to six weeks without injury to the fruit. Late in the fall many of the most sucessful growers in New York, Pennsylvania, and Washington place their grapes in storage and pack them later in a packing house.

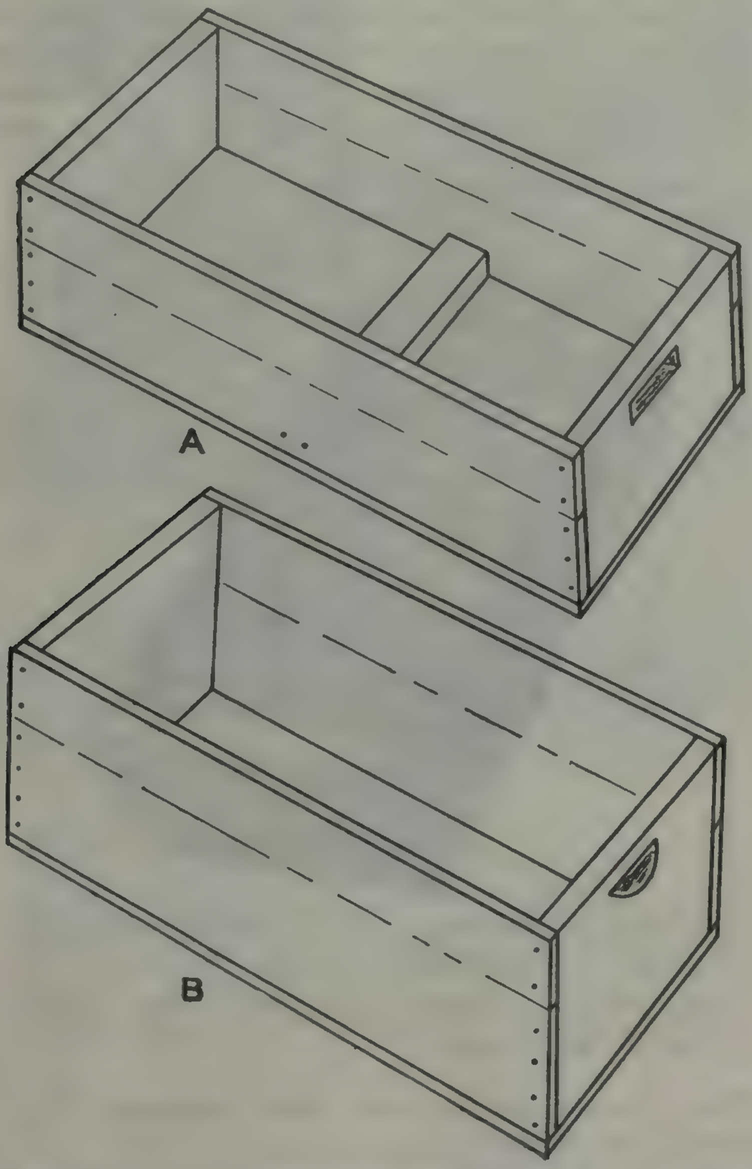


FIG. 10.—A, type of field picking tray in most common use. Outside dimensions, 24 inches long, 12 inches wide, and 6 inches deep. B, type of field picking tray used to a limited extent. Same dimensions as A, except that it is 2 inches deeper

Grapes are stored at temperatures ranging from 32° to 50° F. Careful attention should be given to the humidity of the storage chamber to preserve the fresh, plump appearance of the berries. Some growers sprinkle the grapes, but this practice is not recommended unless it is carried on under the supervision of an experienced foreman.

The finest packs of table grapes are put up in packing houses. The packers operate under almost ideal conditions as far as personal comfort is concerned. They are provided with clippers for the purpose of removing all crushed, cracked, and blemished berries as well as long, unsightly stems. The stems of the bunches of grapes to be packed in these houses are always permitted to wilt before the grapes are delivered to the packers. This permits bending the bunches to conform to the available space without cracking or bruising the berries. Much care is exercised in securing an even and attractive top and a tight pack.

There are several types of packing houses, one of which is shown in Figure 13. Here the grapes are delivered at the receiving door and trucked to the packing tables. When empty the field boxes are stacked on the platform at the end of the house to be returned to the growers. The packed baskets are then trucked (fig. 14) to the loading platform for loading into the cars.

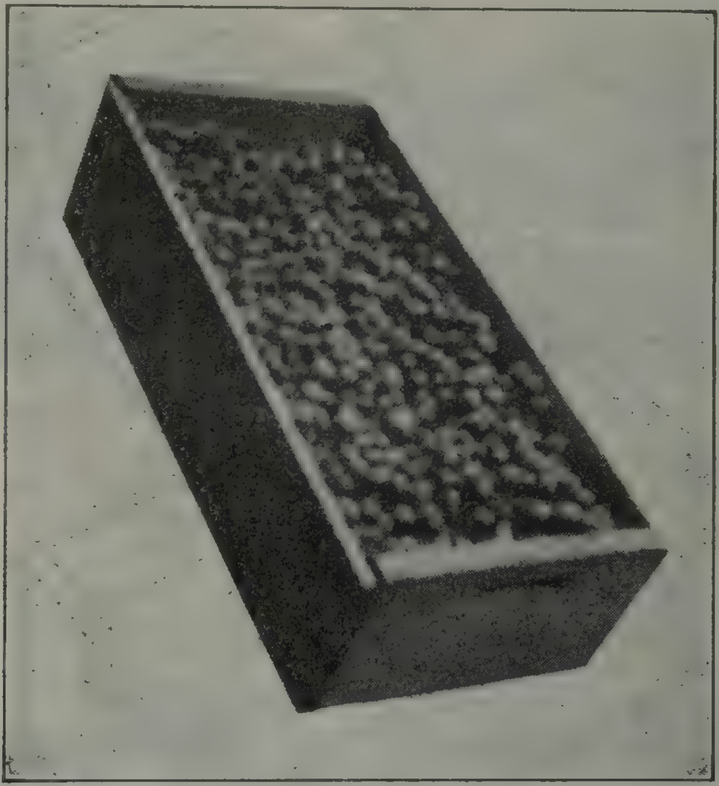


FIG. 11.—Tray properly filled with grapes. These grapes will not be bruised when trays are stacked one on top of another

Empty baskets are stored in the second story of the building and are delivered to the packers through chutes.

Several types of packing benches are used, but Figures 15 and 16 show the most practical type, although some packers like the bench illustrated in Figure 12. The only difference in the tables shown in Figures 15 and 16 is the size of the unit.

Some packers place an attractive colored pad under the cover and place a label on the cover. A convenient labeling machine is shown in Figure 17. The paste is placed on the basket cover by drawing it over the roller, after which the label is placed. An experienced operator can paste 4,000 to 6,000 labels a day with this device.

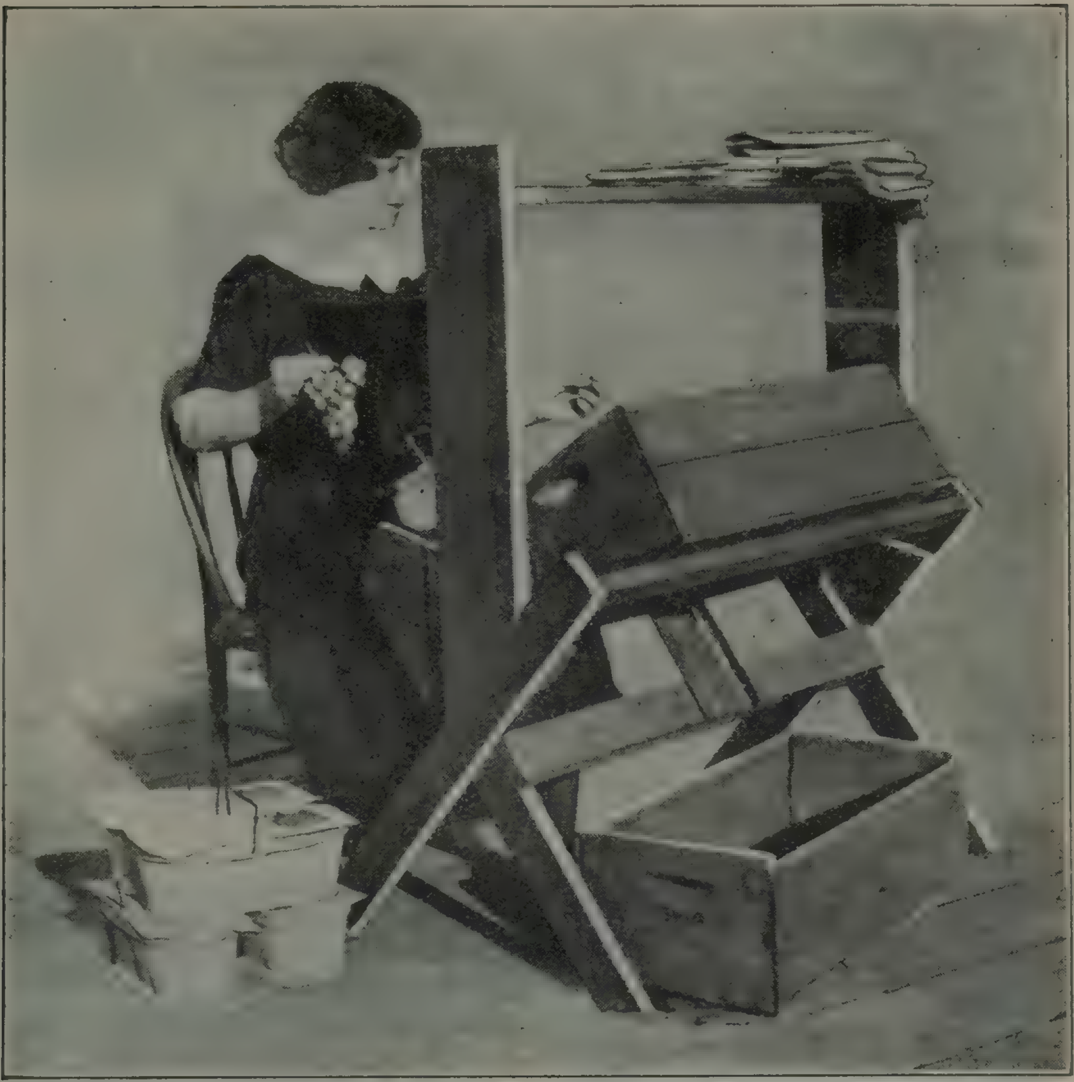


FIG. 12.—Single-unit packing table. Note box on floor for cull grapes

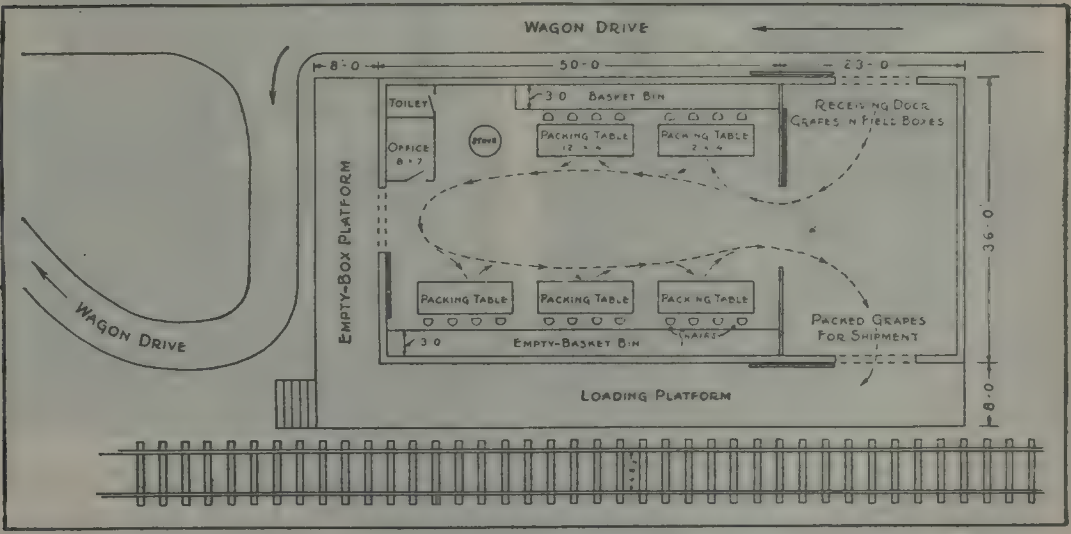


FIG. 13.—Floor plan of grape-packing house. Note arrangement of packing tables, packers' chairs, and basket bins

PACKAGES

Climax baskets are standardized under the provisions of the United States standard container act in three sizes, namely, 2 quarts, 4 quarts, and 12 quarts. (Fig. 18.) The first two are used for the table-grape packs. Within the last few years several types of wire handles have been developed for these sizes which have rapidly replaced the wooden handles formerly used and which are still com-

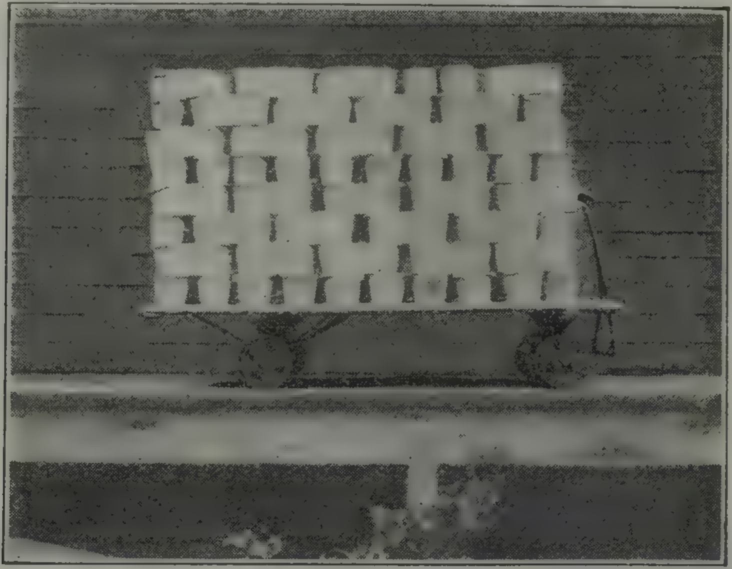


FIG. 14.—Hauling packed 2-quart baskets from packing room to the car. Note methods of stacking baskets on truck

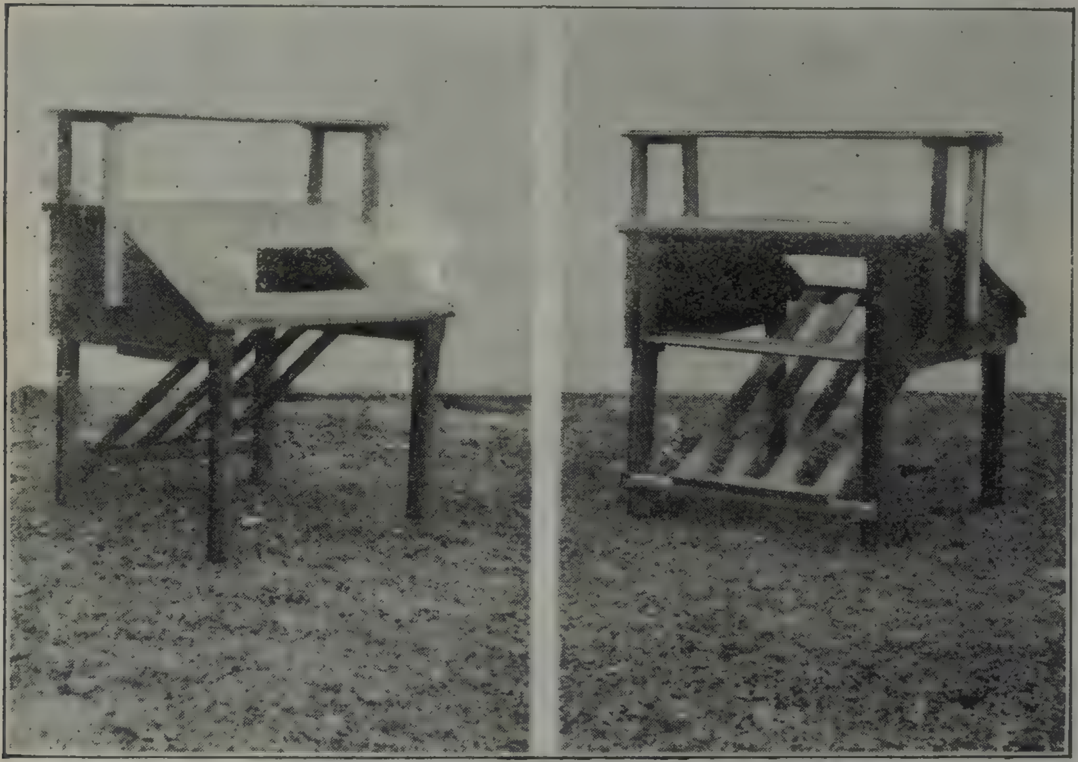


FIG. 15.—Front and rear views of a one-unit packing table. Grapes are placed under the shelf on top of the table by the tender and are pulled forward by the packer. The lug containing cull grapes is pushed down through the hole to the rear of the table. Packed baskets are placed on the shelf above the table, from which position they are removed by the tender

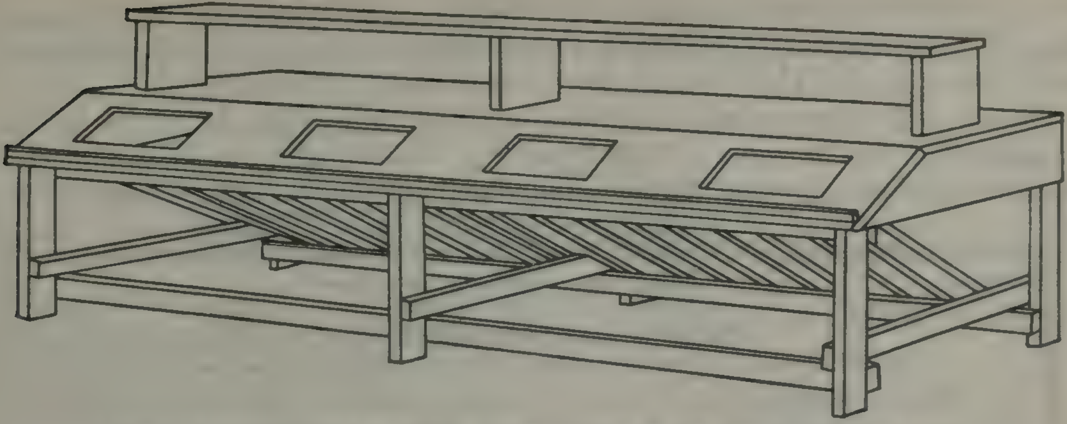


FIG. 16.—Four-unit packing table. This is the most practical size

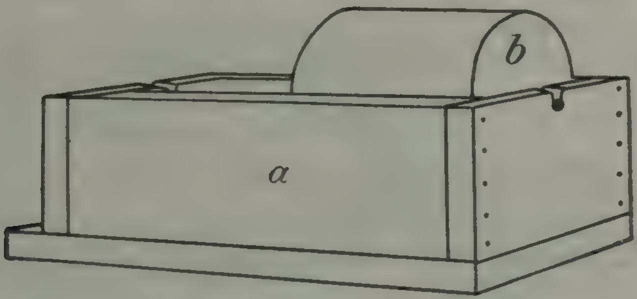


FIG. 17.—Labeling machine consisting of (a) metal-lined water-tight box and (b) cloth-covered roller

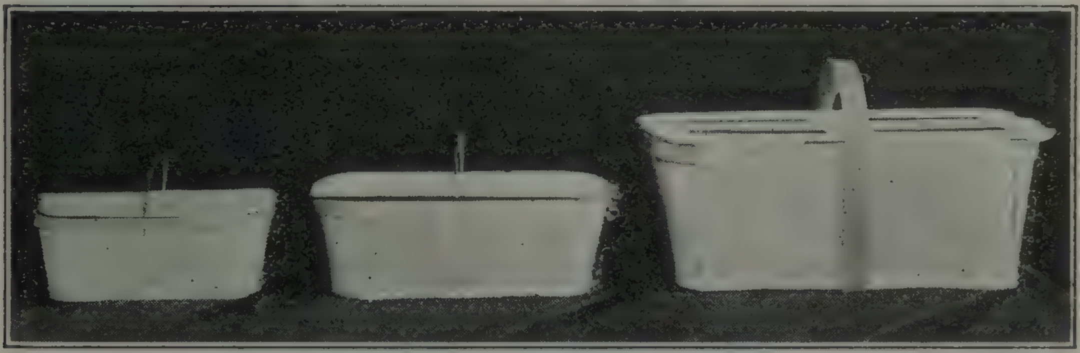


FIG. 18.—Most eastern grapes are marketed in standardized Climax baskets, which are made in 2, 4, and 12 quart sizes

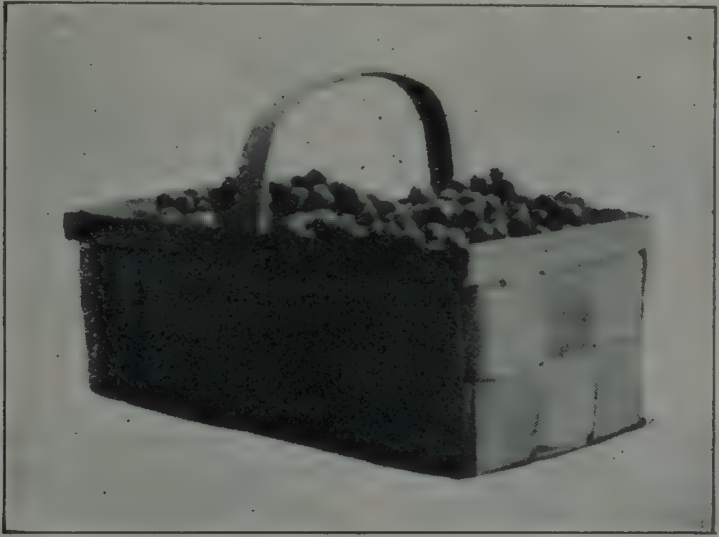
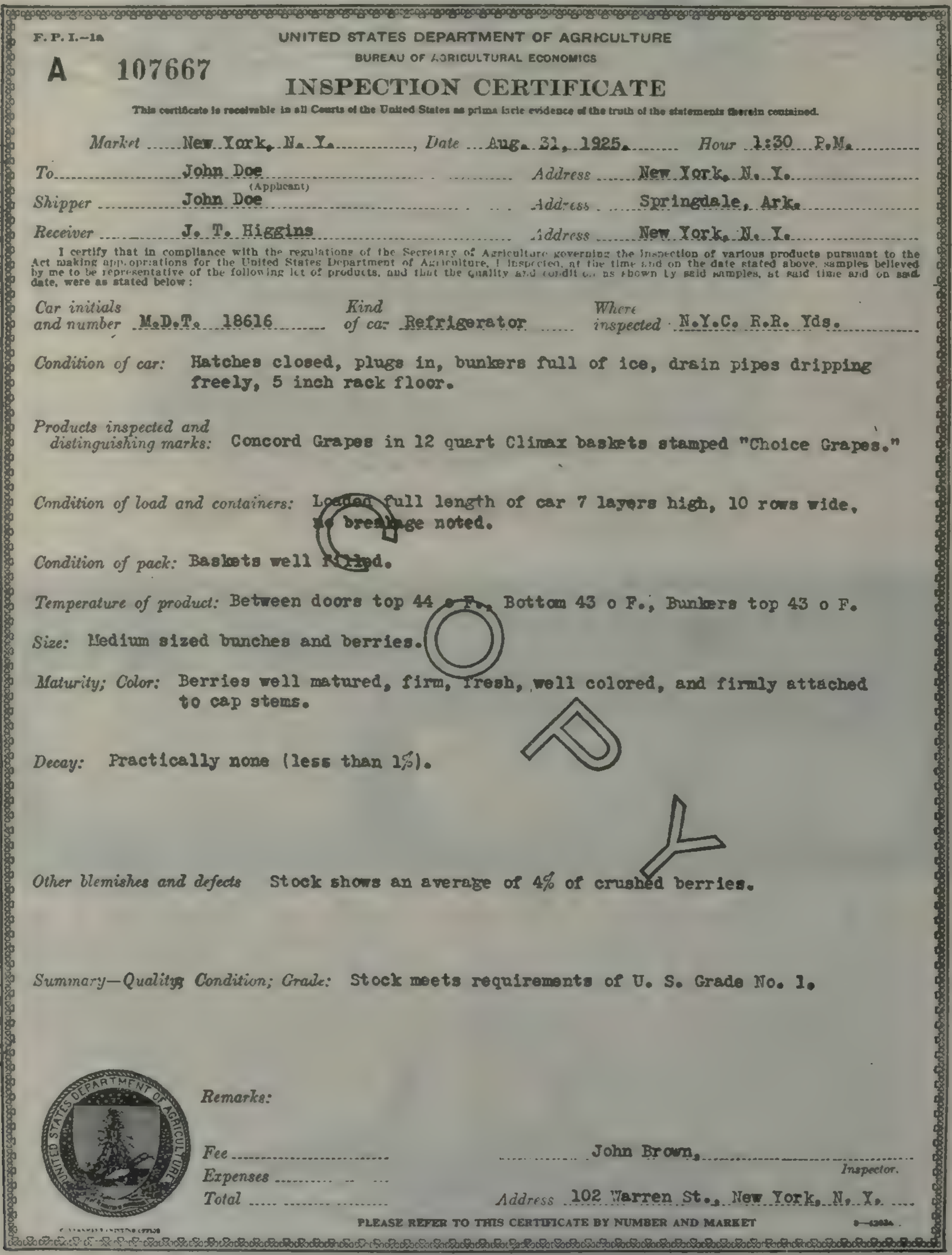


FIG. 19.—Twelve-quart square-cornered splint basket used at a few local markets. Grapes are seldom shipped in this type of container

monly used for the 12-quart size. These wire handles are satisfactory if the basket is properly made and if the wire is sufficiently heavy to prevent the top of the basket from spreading.

Every year some grapes are shipped in bushel round stave baskets, a package wholly unsuited to grapes. The fruit so shipped invariably arrives on the market in a crushed and leaky condition.



F. P. I.—1a

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF AGRICULTURAL ECONOMICS

A 107667

INSPECTION CERTIFICATE

This certificate is receivable in all Courts of the United States as prima facie evidence of the truth of the statements therein contained.

Market New York, N. Y., *Date* Aug. 31, 1925. *Hour* 1:30 P.M.

To John Doe (Applicant) *Address* New York, N. Y.

Shipper John Doe *Address* Springdale, Ark.

Receiver J. T. Higgins *Address* New York, N. Y.

I certify that in compliance with the regulations of the Secretary of Agriculture governing the inspection of various products pursuant to the Act making appropriations for the United States Department of Agriculture, I inspected, at the time and on the date stated above, samples believed by me to be representative of the following lot of products, and that the quality and condition as shown by said samples, at said time and on said date, were as stated below:

Car initials and number M.D.T. 18616 *Kind of car* Refrigerator *Where inspected* N.Y.C. R.R. Yds.

Condition of car: Hatches closed, plugs in, bunkers full of ice, drain pipes dripping freely, 5 inch rack floor.

Products inspected and distinguishing marks: Concord Grapes in 12 quart Climax baskets stamped "Choice Grapes."

Condition of load and containers: Loaded full length of car 7 layers high, 10 rows wide, no breakage noted.

Condition of pack: Baskets well filled.

Temperature of product: Between doors top 44 o F., Bottom 43 o F., Bunkers top 43 o F.

Size: Medium sized bunches and berries.

Maturity; Color: Berries well matured, firm, fresh, well colored, and firmly attached to cap stems.

Decay: Practically none (less than 1%).

Other blemishes and defects Stock shows an average of 4% of crushed berries.

Summary—Quality; Condition; Grade: Stock meets requirements of U. S. Grade No. 1.

COPY

Remarks:

Fee
Expenses
Total

John Brown, *Inspector.*

Address 102 Warren St., New York, N. Y.

PLEASE REFER TO THIS CERTIFICATE BY NUMBER AND MARKET

FIG. 20.—Facsimile of a farm-products inspection certificate such as is issued by United States inspectors of food products. Note the detailed information given

Splint baskets (fig. 19) also are used to a limited extent for local marketing, but are not practical for shipping, as they can not be successfully stacked in the cars or on trucks without injury to the grapes.

Late in the season juice grapes are sometimes shipped in field picking boxes. These boxes are returned after the grapes are sold.

Only a few shippers have found this practice satisfactory, and the Climax basket is in almost universal use for the shipment of eastern grapes.

STANDARDIZATION AND INSPECTION

Interest in uniform grades for eastern grapes is of recent development. Heretofore, grades which were more or less local have been in use. State standards for grades are in effect in Michigan and Washington, but the grades in use in other districts have been those of individuals, private shippers, and growers' associations. As new interest in the packing of table stock was expressed, requests from various sources were made upon the Bureau of Agricultural Eco-

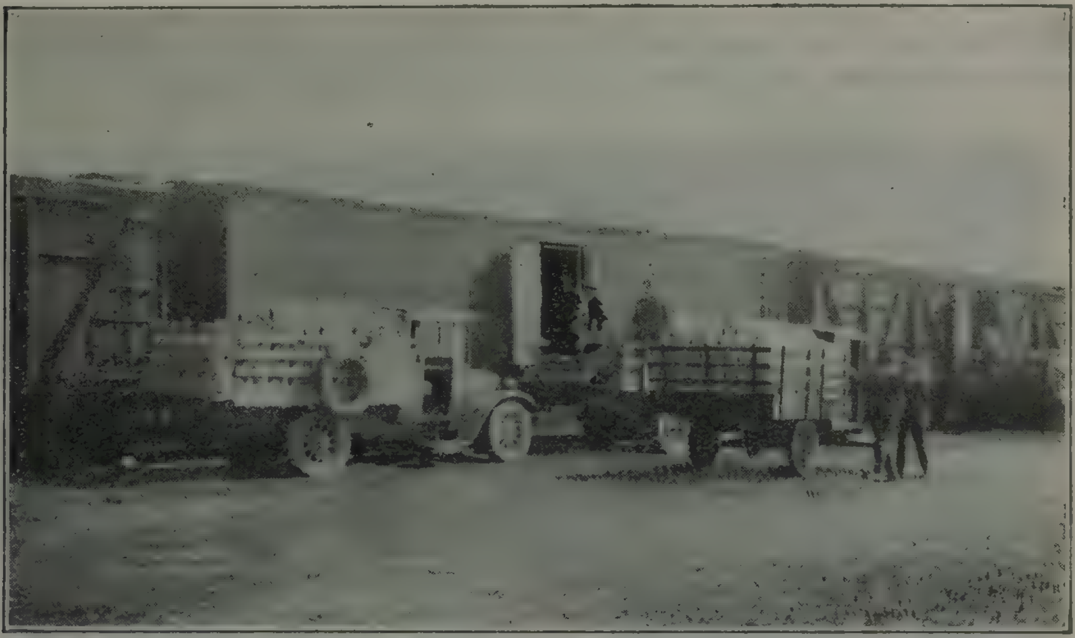


FIG. 21.—Loading grapes into cars

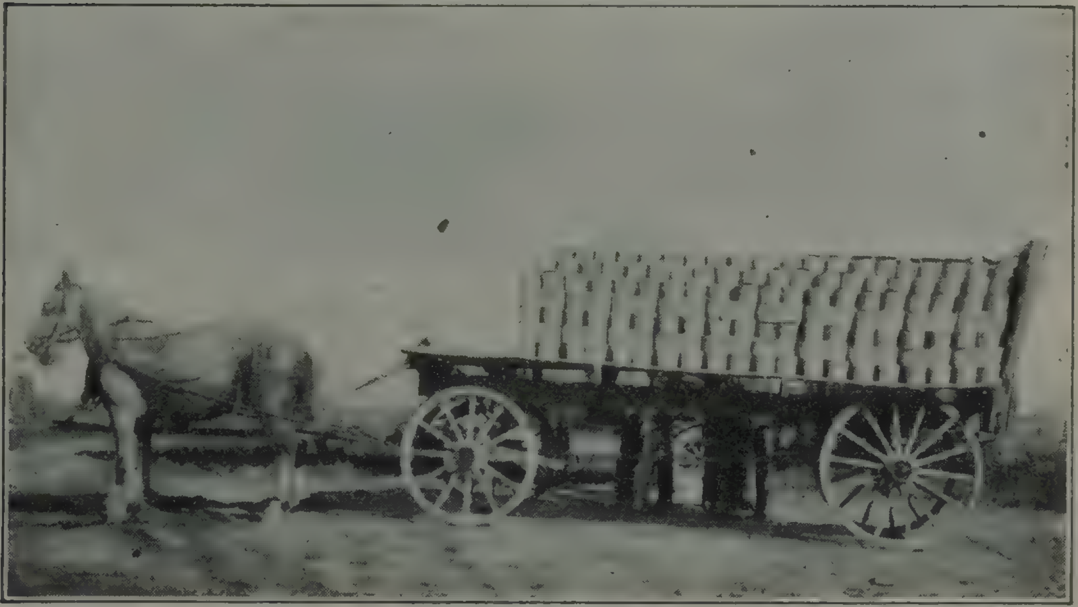


FIG. 22.—Hauling packed 4-quart baskets from vineyard to cars. Note flat rack used on wagon

nomics to determine the feasibility of a national standard for grades. After two seasons of study, standardized grades were recommended which in general terms provided for a premium grade of table stock to be known as U. S. Fancy, a first-class commercial pack of table stock to be called U. S. No. 1, and a third grade of stock, for juice or other purposes, comprised of small or straggly bunches and other grapes that are of inferior appearance but are suitable for shipment. This grade is called U. S. No. 2.

The specifications of these grades are subject to change and are therefore not incorporated in this bulletin. Copies of the latest recommendations may always be secured without charge from the Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C.

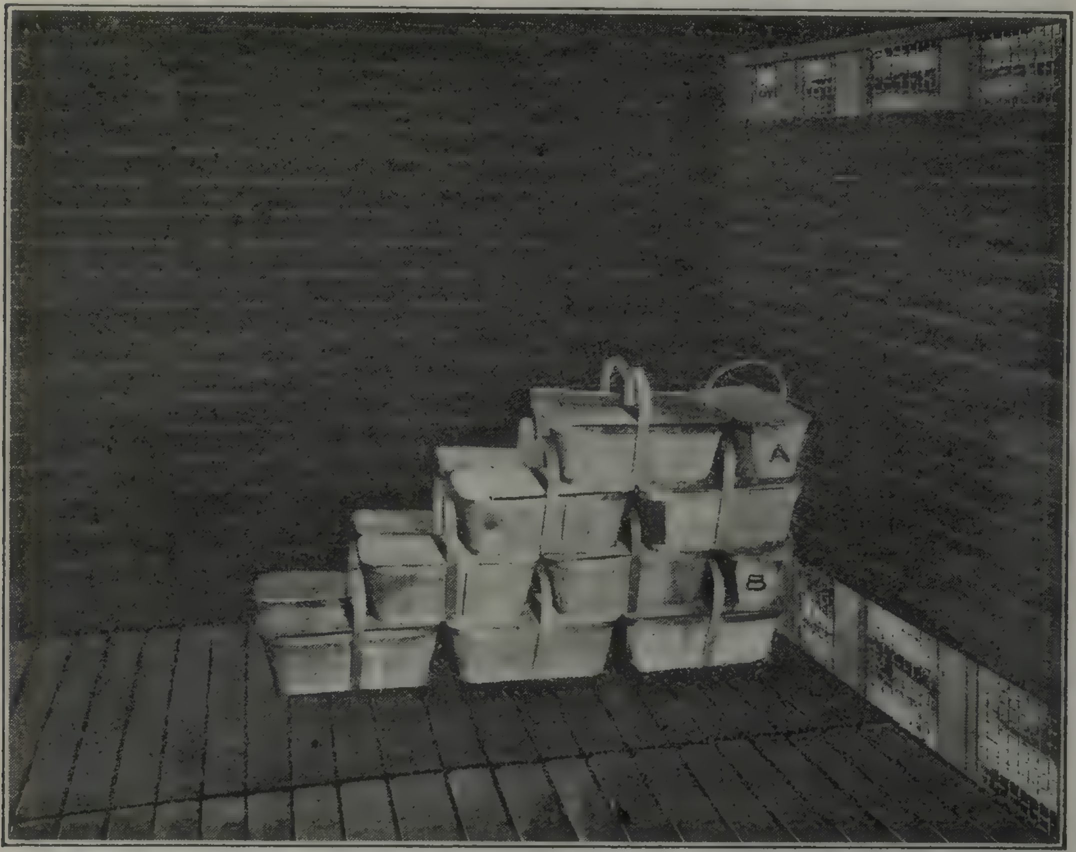


FIG. 23.—Good, snug loading. The only place where baskets should be placed crosswise of the car is next to the bulkhead to fill in spaces that would otherwise be vacant. (Note A and B)

The Department of Agriculture provides an official inspection service both in the leading markets and, by arrangement, at the point of production. Competent and neutral inspection is provided, the certificates showing in detail the condition of the lot at the time of examination. A typical certificate is shown in Figure 20. This service has increased rapidly in popularity as it has proved exceedingly useful to shippers and receivers in connection with sales and adjustments, and to both of them and to the transportation companies in the settlement of railroad claims. Certificates are furnished only on application, and a fee is charged to cover the cost of the service.

LOADING

The successful delivery of grapes to the market depends upon the care with which they are loaded on trucks and wagons and in the cars. Properly loaded trucks and wagons are shown in Figures 21 and 22. The surface upon which the bottom layer rests should be smooth, and the top layers should be stacked squarely on the bottom ones, with no unnecessary space between the stacks to allow shifting.

The proper method of loading a car of Climax baskets is shown in Figures 23, 24, and 25. Figure 23 shows how the "straight" system is started; Figure 24 shows the completed row. Any extra space at the end of the car must be taken up by constructing a bulkhead, whereas extra space at the side of the car may be filled by placing the last row in a diagonal position, as shown started in Figure 25. This row is often referred to as "the worm." Baskets should never be loaded crosswise of the car, except as shown in Figure 23.

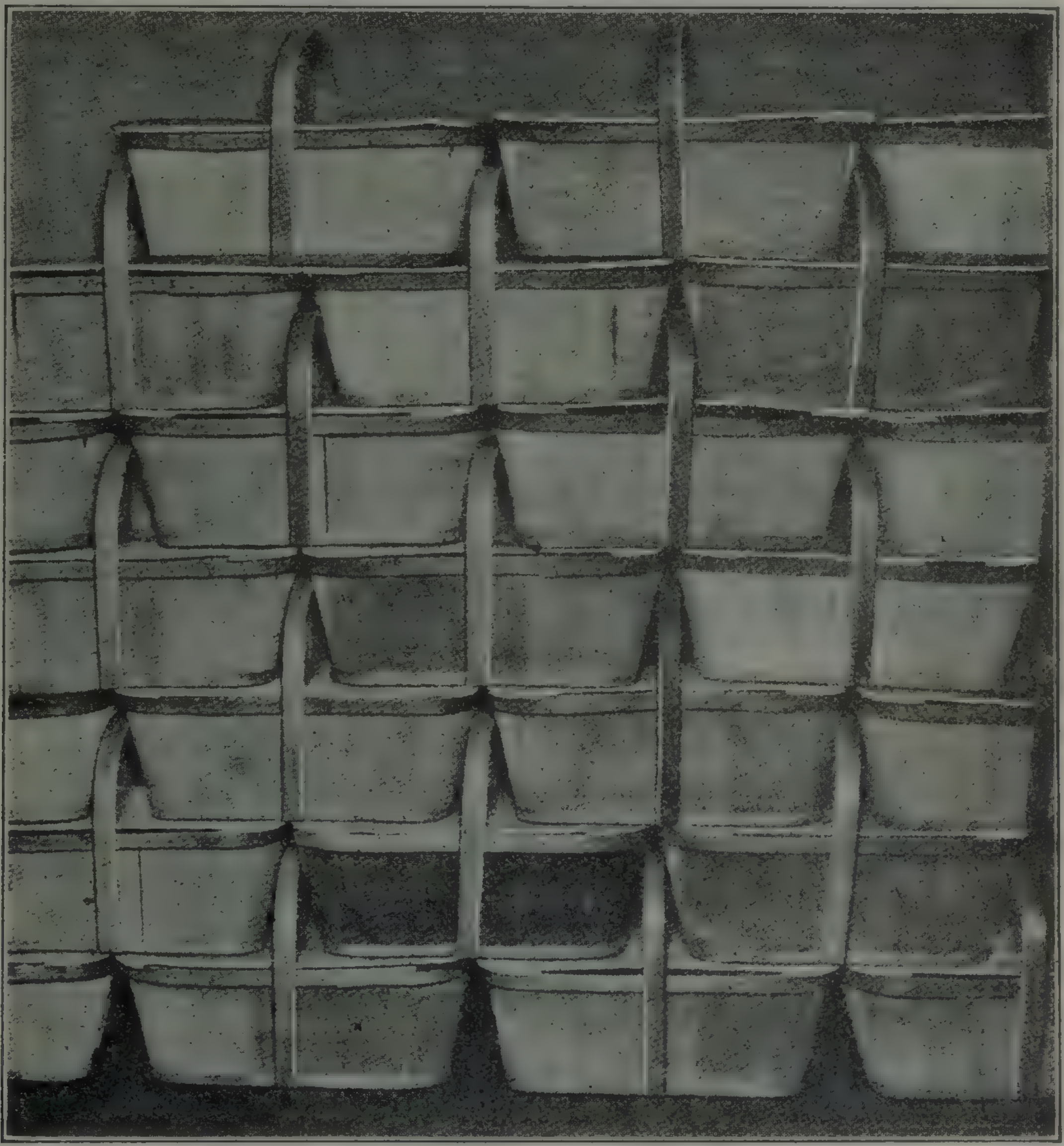


FIG. 24.—"Straight" system of loading. The baskets are well placed, and there is no surplus space between them

All uneven places on the car floor should be leveled before loading.

GRAPES FOR JUICE FACTORIES

Grapes picked for delivery to juice factories should be well colored and high in sugar content. The most careful manufacturers remove decayed and insect-injured berries before placing the fruit in the presses.

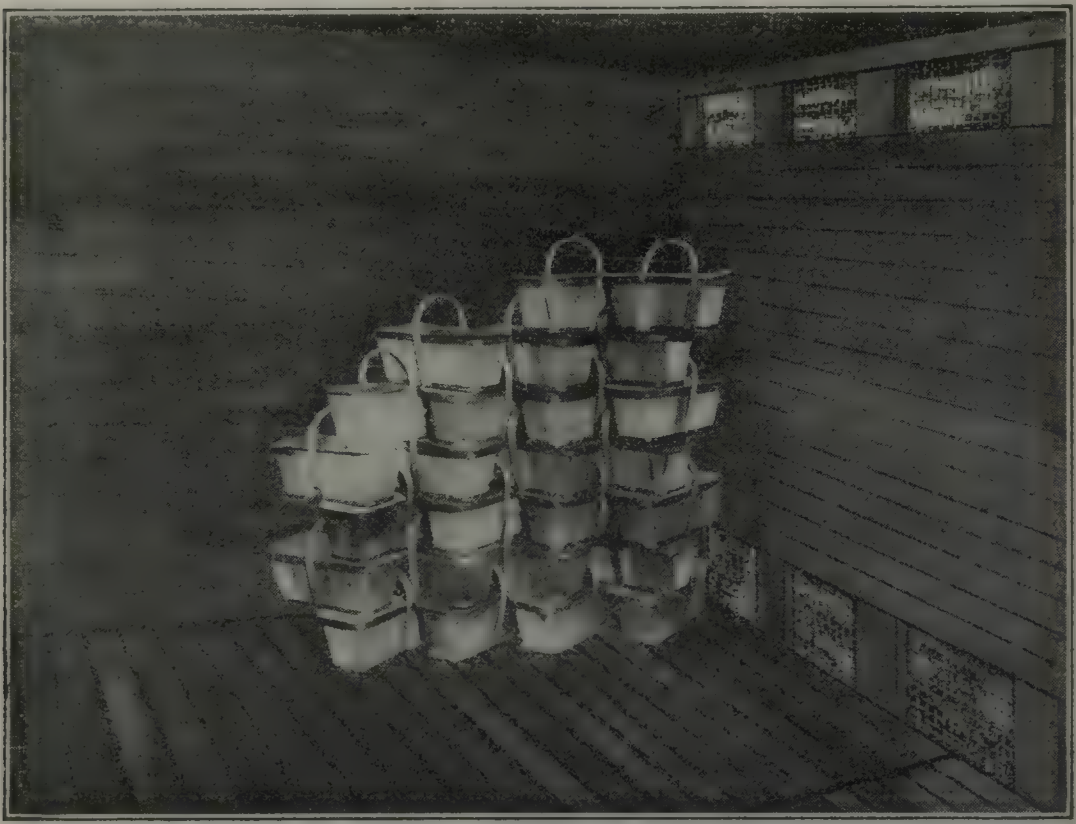


FIG. 25.—"Diagonal" system of loading used in the last row loaded to take up extra space at the side of the car

CORRECT METHODS SIMPLE BUT IMPORTANT

The foregoing discussion indicates that the requirements for packing eastern table grapes are relatively simple. This is true, but such as they are they must be followed with care if a high-class product is to be packed. It has already been emphasized that the enormous expansion of the juice industry in California and elsewhere has made the potential outlet for a larger supply of table grapes a subject of great interest to the industry.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1559

RURAL LIBRARIES

1862 1889

THE MODERN FARMER is taking his place in the general scheme of things. Formerly isolated and segregated, he is now making new contacts. Many factors are bringing this about. Already stirred and awakened by extension activities, he is being made a member of a larger community by the consolidated school and his marketing organization. The telephone, rural free delivery, the phonograph, and the radio bring him the world's news, market information, and good music and entertainment, thus broadening his outlook and stimulating his wishes. The automobile and good roads greatly extend his trading area, widen his travel possibilities, bridge the gap between farm and town, and give him access to educational and cultural activities. The world is recognizing the farmer's new status, especially in a business way. His occupation is acquiring new dignity and power. He is thinking more for himself.

Farm men and women universally insist that their children shall have a better chance in life than they themselves had. Having gone through the struggling pioneer stage of muscular effort and hardship endurance, they demand a better chance for their children. If the farmer wants his children to continue in the farming business he wishes them to be better equipped in education and in modern farm methods than he is. If the farmer wishes his children to take up city occupations he wants them to have an equal chance in the battle of life with city children. Here is where the opportunities and obligations of library service enter. Twenty-seven million farm people with added interests and desires and a quickened curiosity are inquiring and eager for new knowledge. The public library, that great democratic institution, so universal and necessary for city people, should be made available to the farmer as he assumes these new relationships.

Washington, D. C. Issued April, 1928

RURAL LIBRARIES

By **Wayne C. Nason**, *Assistant Agricultural Economist, Division of Farm Population and Rural Life, Bureau of Agricultural Economics*

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EFFICIENCY AND SATISFACTION AS RELATED TO AGRICULTURE

RURAL LIBRARIES naturally grow out of the demand for efficiency in agriculture. Efficiency and satisfaction are the keynotes of successful farming of the future. Skill is taking the place of chance; brain is superseding brawn; intelligence is replacing blind hope; education is displacing ignorance.

The farmer also needs and wants facilities for general culture and for a larger, richer, and more varied life. Along with efficient farming, and perhaps as a product of it, should go a contented farm people and a satisfying farm life. Cold efficiency is not enough. A mechanical type of life is not satisfying. Human elements are to be considered. The desire for financial reward may spur efficiency, but only happiness and contentment can maintain it. Efficiency is a means and not an end. The objective is a good kind of rural life—good homes, schools, churches, libraries, hospitals, and social and recreational facilities. Only these can keep the successful farmer on the farm. Only intelligence and skill can create and maintain a satisfactory farm life.

THE OPPORTUNITY OF THE LIBRARY IN AGRICULTURAL EDUCATION

Education is an important factor in efficiency. Through education farmers can make themselves adequate to the solving of the perplexing problems confronting agriculture to-day.[1] Here is the great opportunity of the library, for the library is recognized as the second line of educational defense. The farmers of to-morrow may be educated for this purpose in the public schools if curriculum makers give agriculture its proper place. In this work the library may well assist. It takes its place in a rural community with the school and the church. (See fig. 1.) The library also has a great opportunity to help educate the adult farmer in his new duties. Whether the library will seize the opportunity presented depends upon the assumption of a rural-minded attitude by the great library associations, by the library training schools, and by librarians themselves. The field is open and is rich in promise.

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[1] Studies by departments and colleges of agriculture of the relation of education to farm income among 4,979 farmers in nine States apparently show that the annual earnings of high-school graduates are 50 per cent greater than are those of common-school graduates and that the earnings of college graduates are 100 per cent greater than are those of high-school graduates.

The modern idea of a library is a service of books rather than a storehouse of books; a librarian is a distributor of books—the right book to the right person at the right time—rather than a custodian of books. The best librarians anticipate the particular book needs of individuals and groups. The efficiency of a library is judged more by the number of books in the hands of people who need them than by the number on the shelves. There is a wide-open field of usefulness for the librarian who sees beyond the immediate need and is able to supply the farmer with the information needed at the time needed, thus helping the farmer to learn to cope with his new responsibilities.

FIG. 1.—Jackson County Free Library, Medford, Oreg.

There is a movement whose extent and future promise of growth are little realized. Adult education means that education does not cease with the school but continues through life. It is usually undertaken as a supplement to some primary occupation, but it also involves general culture. A leading authority points out that there are five times as many adults pursuing some form of educational study as are registered as candidates for degrees in all the colleges and universities in the country. The leaders of the 17,000,000 industrial workers have recognized the importance of adult education by establishing labor colleges, by encouraging attendance at night schools and part-time schools, and by organizing workers' education classes. In this work capital assists. Folk high schools for general culture and adult schools where agricultural cooperation is studied are given much credit for Denmark's great agricultural advance.

Something has been done along the line of adult education for farmers through extension activities, farmers' short courses, vocational education, etc. Part-time and continuation schools are few, however. The dearth of rural public libraries has prevented the linking up of the program with the library. General extension of rural public libraries and cooperation between extension agencies and library authorities should greatly extend the work of adult farm education. (Fig. 2.)

Several California counties have attempted something of the kind in cooperation with the county agent by lending agricultural books and bulletins to farm bureau classes for study purposes. The county library at Greenville, S. C., furnishes books for "lay-by" schools between planting and harvest times for remote farm people of meager education. Over 9,000 farmers enrolled in 1927 in vocational evening classes conducted by agricultural teachers in Southern States.

FIG. 2.—The county librarian (seated) and the county farm adviser of Solano County, Calif., carry books in bags to this public library station in a country school

A few rural librarians are taking full advantage of such facilities as they have for assisting in training the farmer in his special lines of work, but greater use could be made, even by trained librarians, of the large quantity of inexpensive material in the form of publications, bulletins, etc., published by agricultural colleges and departments of agriculture, along farming and home economics lines. The former idea that book knowledge is useless is passing. The librarian can do much to eradicate it by offering from his library material definite solutions for particular farm problems. The few librarians who do make effective use of Government publications among farm people are enthusiastic as to results.

As the demand for efficient farming and a satisfying farm life becomes insistent, a great interest in libraries may be expected to arise among farm people.

LIBRARY FACILITIES FOR FARM READERS

When facilities for library service for rural people are examined, some striking facts are found. According to figures given by the American Library Association there are 5,954 public libraries[2] in the 3,065 counties in the United States. But 1,135 counties have no public libraries within their borders. It is estimated that 45,069,897 people are without public-library service. Of these 42,152,291, or 93 per cent, are rural (living in the open country or in places having less than 2,500 population). Eighty-two per cent of the rural population of the United States do not have public-library service, as compared with 6 per cent of the urban population who do not have such service. This does not take account of State service. The deficiency in library service to negroes is even more impressive.

The cost of this public-library service in the United States, in a recent year, was $35,347,156, or 33 cents per capita for all people of the United States, or 59 cents per capita for people in public-library-service areas. In rural sections 59 cents will buy one-third of one good book. The national bill for soft drinks is eleven times as large as the public-library bill; the radio bill twelve and one-half times as large, the moving-picture bill twenty-two times as large, and the candy bill twenty-eight times as large as the public-library bill.

Results of surveys indicate that the farm people are readers, especially during the long winter evenings. Their reading matter consists largely, however, of farm journals and local newspapers rather than books. Good books are expensive, and in rural communities they are few and are of limited variety. The executive secretary of the Louisiana Library Commission, who has had much experience in county library work, states that farmers read more informational literature than do city people. Farmers not only read concerning their own business but they want something outside their own special interests. The real test of farm people as readers comes with the use they make of their own public-library facilities where they have them. These indicate a use of books and a library interest which compares favorably with that of city people.

A few towns and cities open their libraries to country people without charge, but these facilities are not used largely by farmers, who are inclined to look upon the library as a town institution for town people, and who hesitate to accept such courtesies. It is in cases where rural people have their own libraries, financed and maintained by themselves, with a trained librarian whose aim is service to rural people, that farm people show their library interest and use of books.

TYPES OF RURAL LIBRARY SERVICE, WITH SPECIFIC EXAMPLES

Public-library service has been recognized as an educational function by legislative enactment, by court decree, and by public opinion.

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[2] "Public libraries" has been interpreted to include all libraries that give general free public service under any form of management and support.

It was nearly 100 years before the ideal of a free public school became established. Meanwhile the free public library is taking its place beside the free public school as an educational institution. Various types of libraries are found in the rural field, such as State extension, membership fee, municipal, school district, township, community, and county libraries.

STATE EXTENSION LIBRARIES

An attempt has been made to relieve the rural-library situation through special State library extension agencies. Massachusetts led off in 1890, and now 40 States have such agencies in operation. These agencies operate through State library commissions and State libraries or as divisions of State departments of education.

The function of these agencies is state-wide library service through aiding the organization of local and county libraries; the improvement of established libraries; giving supplemental book service to existing libraries; and furnishing direct book service to local communities, groups, and individuals until adequate local service is instituted. This last-named service is performed through the establishment of traveling libraries, package libraries, and direct book service to individuals. (Fig. 3.)

TRAVELING LIBRARIES

Traveling libraries were initiated by New York State in 1892, and 35 States now have such service. Such libraries consist of regular and miscellaneous collections of about 50 books, mostly for general reading, sent out to communities, schools, and rural organizations generally upon payment of postage or a small fee. Books may be kept and circulated from three to six months, after which they are returned to headquarters for relending. Some States send collections only to places where there are no local public libraries, whereas others use them also to supplement local libraries. A large number of the collections go to schools for reference work. Some States include special collections on agriculture.

PACKAGE LIBRARIES

Package libraries consist largely of packages of pamphlets, clippings, and material regarding current events for special purposes, such as debates, study courses, and club programs. Packages are usually sent free or upon payment of postage. The system was begun by the Oregon Library Commission in 1905 and many States have followed it. Wisconsin University began similar work in 1906 and now 34 universities offer such service. The number of packages sent out by universities varied in a recent year from 180 packages from the University of Montana to 17,977 packages from the University of Texas. Nine States do not have package library service. Much of the package service goes to schools and some States give especial attention to farmers.

DIRECT MAIL SERVICE OF BOOKS TO INDIVIDUALS

A recent and growing form of State library extension is direct mail service of books to individuals. From one to several books are sent, upon request, for several weeks, the borrower usually paying the postage. Over 600,000 books were mailed out in this way during a recent year. Delaware and Vermont deliver also by book automobile. The service is in no wise confined to rural districts.

State library-extension activities have resulted in great good to many rural people. Many have been supplied with books who could get them in no other way, and many isolated communities have come into touch with the best literature and information in this way. Schools, clubs, and debating societies have received much needed assistance. But no one claims that these agencies are much more than a beginning in relieving the rural book situation. No information is available as to the actual individual circulation of the material, but

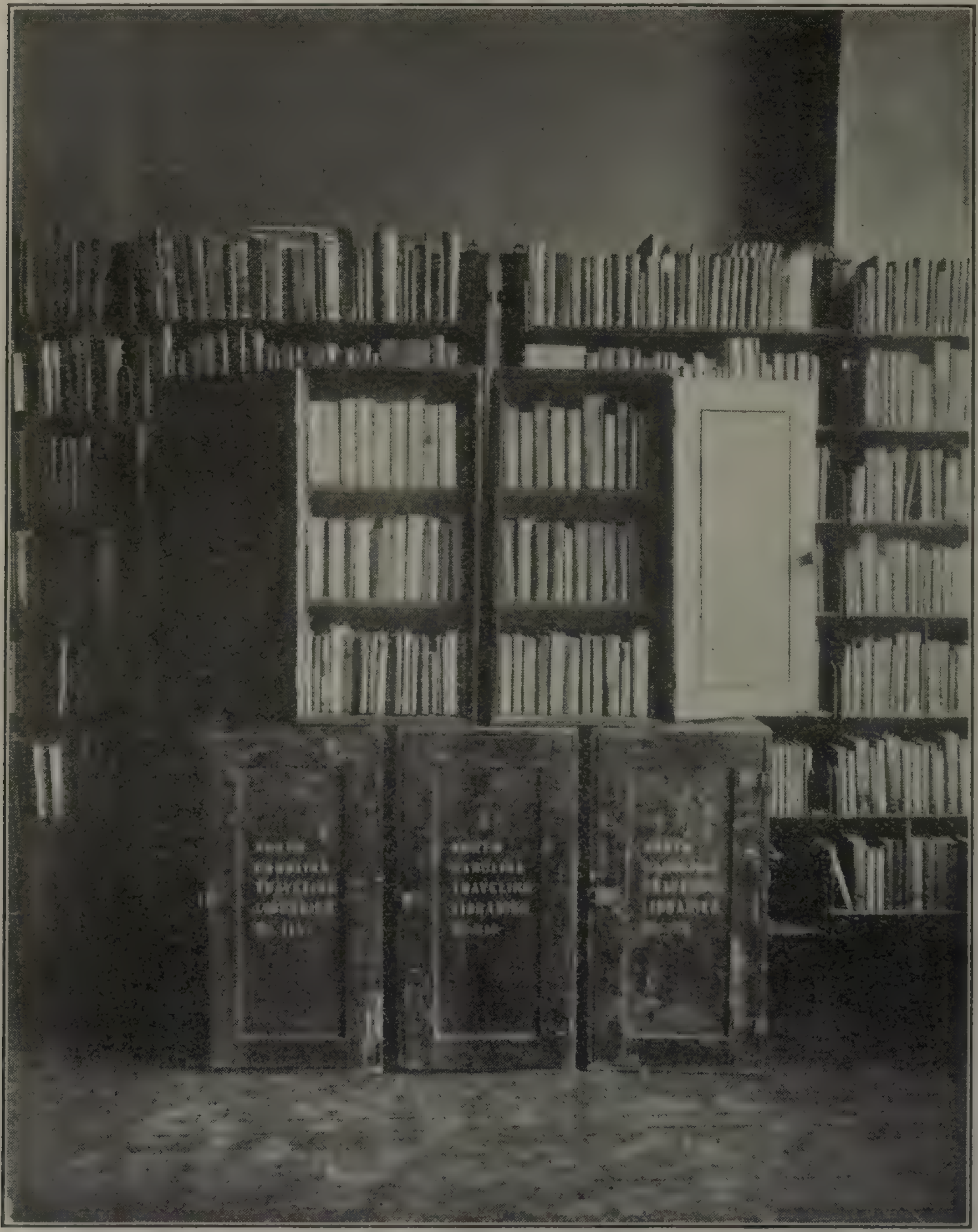

FIG. 3.—North Carolina traveling libraries at Raleigh. Boxes of books are sent to rural communities for temporary use

it is known that much of it does not go to rural people, and a large share of it goes to schools and to local libraries. One and a half million books in 1,900 collections and by direct mail are reported to have been sent out from extension headquarters in the various States to be circulated in the field during a recent year. One important result has been the establishment of many local rural libraries. Massachusetts and California have given up their traveling systems on account of extensive local and county library development. The most important rural service of State extension agencies may be that of encouraging the establishment of adequate local libraries through expert advice from the central office and with the assistance of traveling organizers.

Notwithstanding the good work done, State library extension activities are limited by (1) lack of contact between librarian and borrowers and direct personal supervision and service, (2) ineffectiveness of scattered effort and long-range work, (3) inadequate choice of selection by borrowers, as collections are largely arranged at headquarters, (4) cost of transportation and duplication, and (5) insufficient book supply, personnel, and financial income to render adequate library service to the 43,000,000 rural people who are without local public-library service, even if this were the sole object.

MEMBERSHIP-FEE LIBRARIES

Various methods are undertaken to satisfy book hunger in rural communities. In villages and in many larger places a common form of book service has been the membership library—a group of interested people form a library association with annual membership dues. Book service is usually confined to those who pay the fee, although the library is often freely open to the public for reading purposes. The money received from fees is usually augmented by voluntary contributions and receipts from entertainments. Such libraries are located mostly in villages, but farm people are generally allowed to join, although they do so but infrequently.

Many such libraries have had a precarious and struggling existence. Voluntary or poorly paid and untrained librarians; infrequent opening hours; shifting, rented, or donated quarters; the small number of books, many of them second hand; the constant yearly financial struggle—these are some of their limitations. Such libraries scarcely touch the real book need of farmers, while village people accept them as seemingly the best substitute for something better. Considering their possibilities and limitations, they have much to their credit in the past in service to their membership and have often been the foundation and inspiration of succeeding libraries of better types. They are not public libraries in the sense that tax-supported institutions are, and they are scarcely a factor in solving the problem of book service for farm people.

CLARKSVILLE LIBRARY, CLARKSVILLE, MO.

The first library in Clarksville, Mo., a village of 729 persons, was opened in 1900. A band of women was responsible for its establishment, and for 10 years they kept it going through receipts from entertainments and voluntary public contributions of money and books. For several years the library was in a room of the school building, but as it continued to grow in books and usefulness a home of its own was desired. The women had been continually accumulating money from receipts from rummage sales, food exchanges, local plays, flower shows, lawn fetes, and public lectures and from public contributions. In 1910 the new building was completed, and the opening was a civic and educational event. The building and grounds cost $4,500. The grounds and the brick for the building were temporarily donated, but by 1920 the property was completely paid for through voluntary effort. (Fig. 4.)

The people responsible for the library were interested not merely in books. An early morning visit to this library revealed one of the library board and several members of the club doing voluntary work improving the grounds. The building is of brick, one floor and basement, centrally located, and well planned architecturally. Vines cover the walls, and plantings veil the base angles. Well-kept lawns with trees, shrubs, and a privet hedge add to the setting.

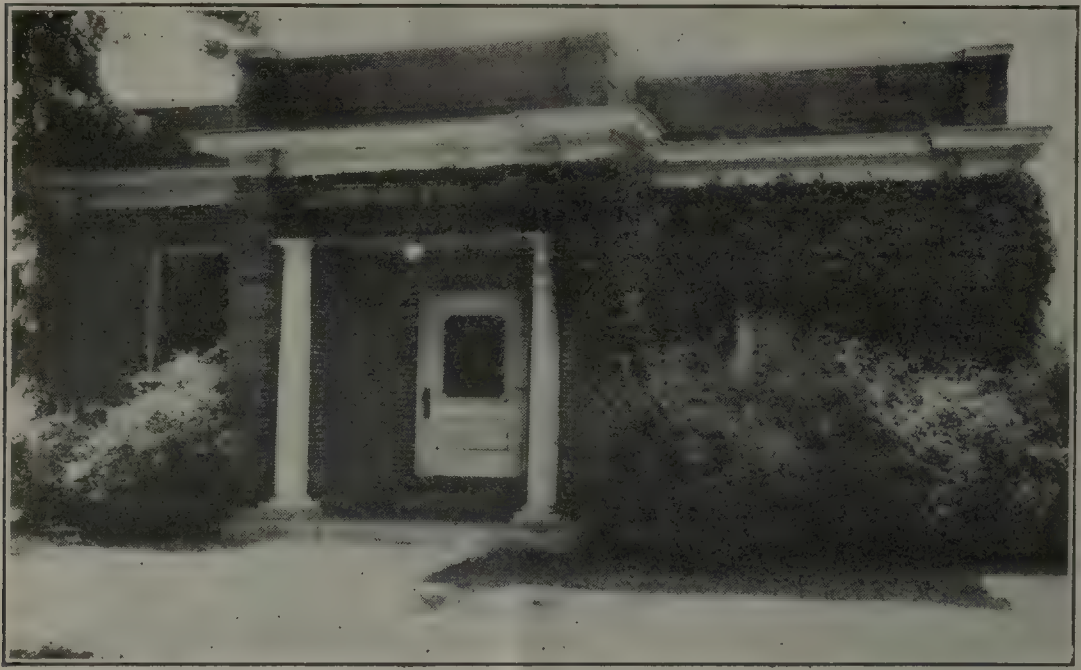

FIG. 4.—The women of Clarksville, Mo., are responsible for this library in a village of 729 people. The cost of the library was $4,500

When the building was dedicated a library club was formed, with $1 annual membership dues which entitle members to use the books and to vote in official matters. Memberships are open to country people, but only 15 have taken them. The members elect a library governing board of 7 members—2 men and 5 women. The building is the property of the library club. It costs $150 a year to maintain the library, and expenses are met by receipts from entertainments. The officials are enthusiastic as to "its great benefit to the people, breaking the monotony of small-town life," and believe that "its growth and appreciation after 26 years demonstrates the need for it and its benefit to the community."

MUNICIPAL LIBRARIES

Municipal libraries, owned and supported by villages and small towns, are rather common in rural territory, especially in the eastern section of the country. They are supported by fixed tax rates or regular sums voted from the general fund. Sometimes they are a donation to the town. Often they are former membership-fee or community libraries that were taken over by the town. They are usually restricted in their use to citizens of the municipality, but they sometimes extend their facilities for a fee, or infrequently, as a courtesy to neighboring farming communities, especially where efforts are being made toward town and country cooperation. They frequently serve fairly well as rural institutions to the people of small municipalities, but they are not often acceptable service institutions to farm people, who find them inconvenient on account of distance and infrequent opening hours. They consider them as town institutions in which they have no part and in the ownership or control of which they do not share.

Many such libraries have been instruments of service, but their sphere of usefulness is often limited, according to modern conceptions of library functions, by insufficient funds received from so small a taxing unit. Thus it is impossible to have a trained librarian or a comprehensive supply of books or to do extension library work. With the small salaries paid, the way is open for appointments based on need rather than skill. Early library history in small towns, however, is replete with notable exceptions in which ill-paid librarians with little or no training or experience have performed exceptionally meritorious service.

VILLAGE LIBRARY, THORP, WIS.

For 15 years the people of Thorp, Wis., a village of 796 persons, have been taxing themselves to support a library and make it freely available to farm people. The library-use line of demarcation between village and country people does not exist. Although the country people are not taxed for village library privileges, they use them freely and join with the village people in voluntary financial support of the library.

The library had its origin in 1893 in a small traveling library sent out by the State. Stimulated by this, but wishing something better, many people donated books for a library. About 1901 a local women's club adopted the library as its special project. Its early support was derived from receipts from entertainments sponsored by the club and participated in by town and country people alike.

While the club was industriously working to support the library by increasing the book supply, it was systematically laying aside a building fund. In 1906 the club purchased a building and fitted it up for library purposes at an expense of $300. (Fig. 5.) In 1911 the village itself came to the support of the library by voting a 0.5 mill maintenance tax, and the library was placed in the name of the village. As the library continued to grow in usefulness the club proceeded to accumulate a fund, through receipts from entertainments, for a permanent building, meanwhile voting a sum for yearly maintenance.

In 1926 a visitor to this small village is impressed with the library interest in the community as typified by a new, attractive, well-planned building, well placed on grounds made inviting by trees, flowers, and shrubs. The building, 46 by 18 feet, is of wood with stucco finish, and has one floor and a basement. In the basement are the workroom, storeroom, furnace, and toilets. There is a hot-air one-pipe system of heating and ventilation. The library proper, on the first floor, receives adequate light from the high windows and the electric-light system. The floor is covered with linoleum and the furniture is of oak. The clock was presented by the American Legion, and a silk flag was given by the woman's relief corps.

The building and lot together are valued at $5,500, including materials from the old building, the trading of lots, etc. Actual financing involved $4,200, of which $2,500 came from the women's club; $1,000 remained from a Red Cross fund and $700 was accumulated by the library board. The village itself gave nothing to finance the building, but had previously raised the library maintenance tax from 0.5 to 0.8 mill.

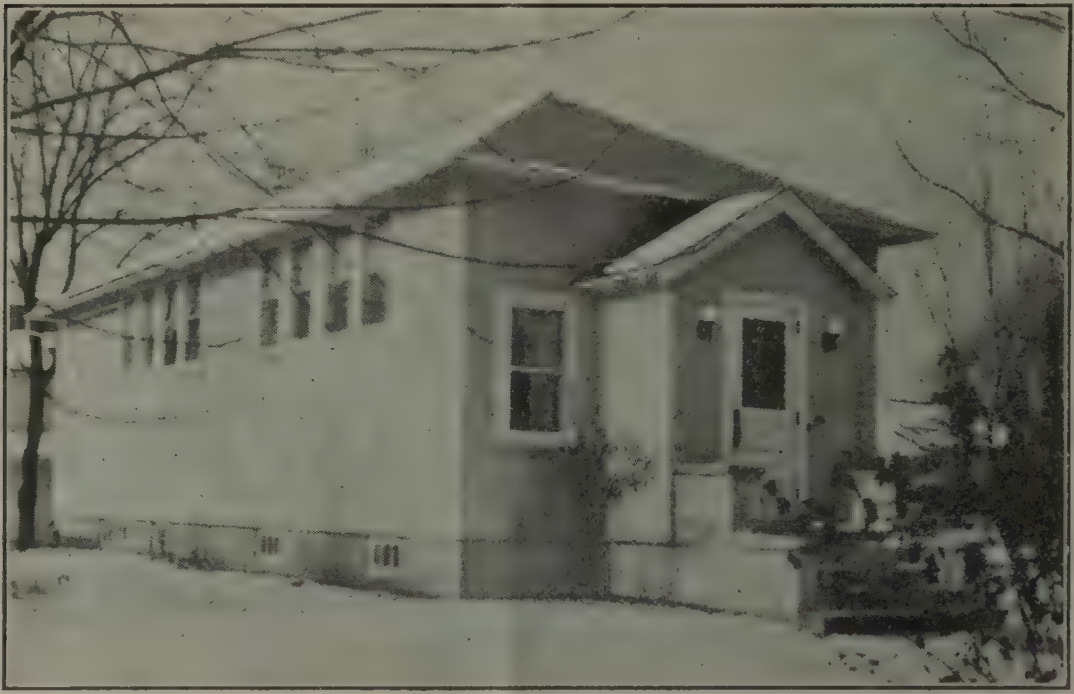

FIG. 5.—Voluntary town and country effort erected this $5,000 municipal library building at Thorp, Wis.; population, 796. The library is maintained by village tax

There were over 3,000 volumes in the library, and 761 active borrowers' cards were in use in 1926. The influence of the library as a community institution extends into the country 8 to 10 miles, but there is no limit to its sphere of activity. It is supported and used by country people and is of especial assistance to the pupils of the high school. Like larger libraries, it features story hours for children.

The library received $1,075.75 for support from the village treasurer for the 13 months ended January 31, 1927, of which about $866 was village tax money and the remainder had been deposited by the women's club. Current running expenses are taken care of by money from book fines, a fund which the library retains. The assessed valuation of the village in 1926 was $955,423.

The library is governed by a board of three trustees appointed by the village president, and is open six hours a day three days a week. A new librarian was appointed in 1926, and the salary schedule was increased. The mediums of library publicity are local newspapers and bulletin boards.

As they now have a library building, it is natural to expect a greater extension of the use of library facilities to rural people.

SCHOOL-DISTRICT PUBLIC LIBRARIES

School-district public libraries are found in Ohio, Missouri, Delaware, and other States. The school district is the unit for public-library taxation and administration. The district may cover only a municipality, or it may extend into rural sections; it may be a country district, often a consolidated-school district; it sometimes covers more than a township.

In Ohio the library may be established by the board of education, but it is administered by a separate board of library trustees appointed by the board of education. The trustees hold title to the property, erect buildings, appoint the library staff, prepare the budget, and set the tax rate—the rate not to exceed 1½ mills, which may be modified, but not arbitrarily, by the board of education.

Eighty-six libraries have been established under this law in Ohio. Many have changed from municipal or membership libraries in order to secure an adequate income. The Cleveland and Dayton public libraries are school-district libraries. Ohio also has the county-unit system.

SCHOOL-DISTRICT PUBLIC LIBRARY, MILAN, OHIO

About 1877, a group of citizens formed the Milan Library Association. Through public subscriptions $50 was raised, and 100 books were purchased. Drug and jewelry stores housed the library for many years. Books were added gradually through receipts from entertainments and through a 50-cent membership fee.

In 1891 the township trustees levied a tax of 0.1 mill on village and township property for the maintenance of a township library, and the property of the library association was turned over to the township. The 50-cent membership fee was continued. The room rent and librarian's salary together were $25 a year. In 1896 the library of 450 books was moved to the office of the clerk in the town hall. In 1899 the income from the township tax was $99 and from memberships $39, for a library of 750 volumes. The librarian's salary was $35 a year.

In 1909 the township tax levy was increased to 0.3 mill, and produced a yearly income of $375 for a library of 2,000 volumes. The library was made a free township library, and the librarian's salary became $60 a year. The number of patrons increased during the following year from 75 to 250.

The new interest taken in the library resulted in a demand for a permanent building. Two residents gave lots for the site, the Carnegie Corporation of New York gave $10,000 for the building, and the township guaranteed a stated sum for maintenance. (Fig. 6.) The new building was dedicated in 1912. Bronze tablets in the library give recognition to the donors. Milan has been fortunate in having local citizens who have been willing to give time, energy, and substance to the library. The people have been ever ready to assist the library through benefit entertainments. Moreover, one of the donors of the library site, a former citizen, gave an endowment of $6,000 (the interest to be used for books) and a collection of autographs and pictures. A woman citizen gave $1,000 for similar purposes.

In 1925 it was decided to take advantage of the Ohio school-district library law, as amended in 1923. The township board by resolution turned the library over to the board of education of the school district, which has a larger territory and a population of 1,721. The board of education appointed a board of seven library trustees, including the three former members. Of these, three are farmers. The library board has charge of the expenditure of funds and the administration of the library and holds title to the library property. The library board prepares the library budget and submits it to the school board, which levies the tax. The tax was 0.75 mill in 1925. This money does not come from the school fund, and the tax is made above the general 15 mill limitation.

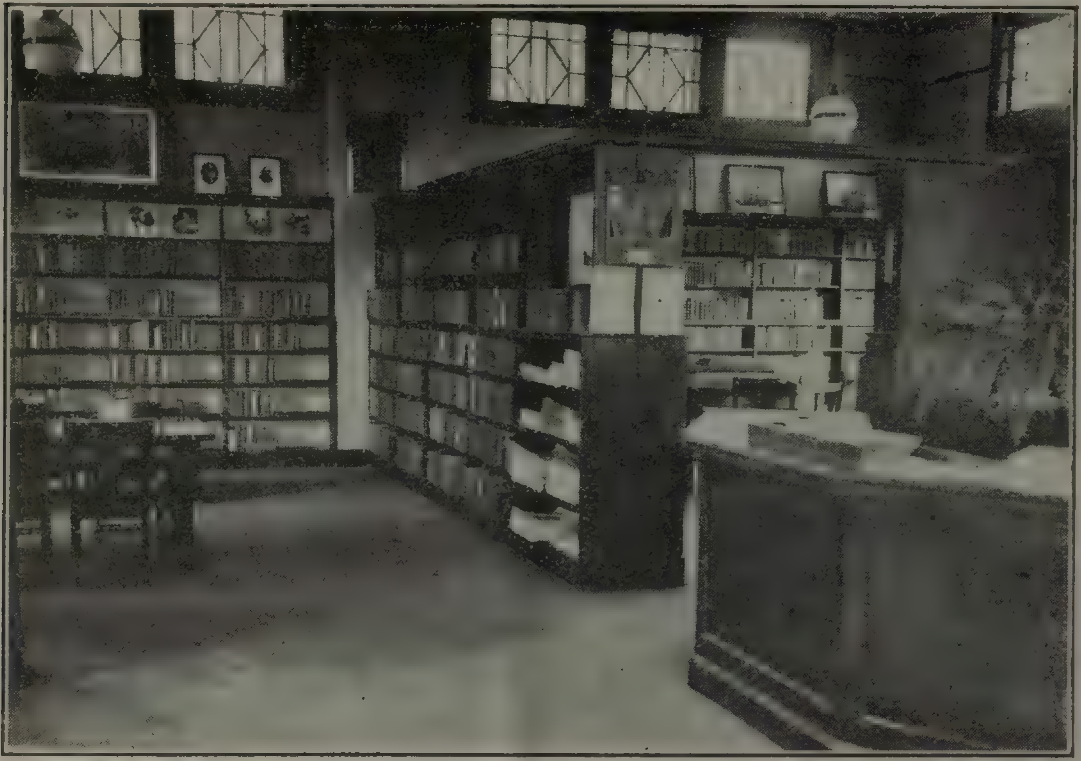

FIG. 6.—A corner of the school-district public library at Milan, Ohio

In 1926 there were 7,556 books, periodicals, pictures, etc. in the library. There were 1,076 active borrowers' cards, three-fifths of them held by farmers. The circulation was 19,785 books—11.43 times the population served. The books are used much by the schools for reference purposes; sets of 25 or more books are placed in the rooms of grades above the first. Pupils also have access to the main library. The librarian gives a short course in the schools on the use of the library and one on library economy and cooperates in the pupils' reading course.

The library was open 307 days in 1925, 10½ hours a day except during school vacations, when it was open 5½ hours. The librarian had three part-time assistants during the year. The building has an assembly room which was used 115 times for public purposes.

Financial statement of school-district public library, Milan, Ohio, 1926

Receipts:	
Taxes, school district	$2,803.80
Taxes, county	52.70
Interest from endowments	351.00
Fines	53.43
Gifts	2.10
Miscellaneous	9.45
Total	3,272.48
Unexpended balance from previous year	857.10
Grand total	4,129.58

Expenditures:	
Books and periodicals	$646.42
Binding	97.50
Salaries, library service	1,608.26
Salaries, janitor service	112.60
Heat and light	397.14
Insurance	77.25
Miscellaneous	121.79
Total	3.060.96
Balance on hand	1,068.62
Grand total	4,129.58

The school-district valuation for tax purposes is roughly $4,000,000. There is a small collection of books from the county library in this library.

Publicity is given to the library through monthly reports, lists of new books, and occasional notes in the local paper; through notices of library hours posted in public places; and through the annual celebration of library day. During the 1925 celebration there were 500 visitors, and a social program was held in the assembly room. As a result 70 new library cards were taken out. Children's book week is celebrated annually.

TOWNSHIP LIBRARIES

There are 475 township libraries in 13 States, mostly in the Middle West and in New York. The first State constitutions of Indiana and Michigan provided for them, but the provisions were not universally carried out. As the leading town becomes more populous it often adds its separate tax support to the township library which becomes more of a town library. In populous and wealthy townships, the township may be a unit of effective service as it is easily supervised and people are near the library. Some well-to-do township libraries support book automobiles for delivering books to rural branch libraries. In townships that are less wealthy and populous the amount of tax support is not sufficient to give effective service to rural people. In New England the rural-library unit is often the town, comparable to the western township.

TOWNSHIP LIBRARY, OTSEGO, MICH.

When the first settlers came to the Otsego country in 1839, it was a wilderness, and railroads were unknown. Notwithstanding the hardships of felling forests, building roads, and fighting wolves, these pioneers early laid the foundation for a good kind of rural civilization, for it was in 1844, only five years after the first settlement, that the township people in town meeting voted $25 to start a township library.

The library went through the usual vicissitudes. It was transferred from the town clerk's office to private homes and in 1861 to the new town hall. Good books were difficult to buy. There came a lull in library activities. Some of the village people thought they should have a library of their own, and a women's library was organized in the seventies with great enthusiasm. The enthusiasm carried so far that a library building was erected through a great display of community effort in securing money and voluntary labor. Considerable money was borrowed and was later repaid through receipts from entertainments.

Enthusiasm for the women's library finally waned, however, and in 1905 the building and books were sold to the township for $1.500, which money was turned over to local churches. Then began a period of success for the township library, which in 1911 had 3,000 books. New books were bought or were donated. Money and labor were donated for painting the building, buying new equipment, installing steam heat in the building, and improving the grounds.

Meanwhile the village of Otsego increased in population and wealth and became incorporated as a town. Under the new scheme of maintenance the library, in 1925, received $1,021.31 from taxation in about the proportion of township one-third and town two-thirds. Receipts from other sources amounted to $101.47. Expenses were $1,116.67, of which $282.27 was spent for books and $456.55 for salaries. The town and township maintain a rest room in the library building.

There are 933 registered borrowers and 4,695 books. The circulation is 20,189 books and 1,503 magazines, one-fifth of which represents circulation to rural people. During 11 months the number of persons who read in the library was 4,643, and in 4 months searches were made to answer 270 questions. The library supplies country schools with books, pictures, magazine files, etc. It is open three afternoons and evenings each week. There is no special library board, but there is an advisory committee on the choice of books.

The building is a wooden one-story-and-basement structure, 60 by 40 feet in size. The library occupies the first floor; the public rest room and a health center occupy the basement.

The library has about 1.000 Government publications, many of them bulletins, each in a separate classified envelope.

What the library has to offer is made known to the public through biweekly announcements in newspapers; through distribution of book lists; and through furnishing country schools with pictures, magazine files, and reference books.

COMMUNITY LIBRARIES

The phrase "community library" as here used means a library that is open freely to the people of a community; that is not supported by taxation or membership dues but rather by the voluntary common interest of the people of the community; that extends its usefulness to all in the community; that is used by a very considerable part of the community; and that, although perhaps sponsored and ultimately controlled by a single organization, is the care and charge of all the people. Libraries of this type are maintained by annual drives and receipts from entertainments, generally with a woman's organization as sponsor. With no assured sums for support, their financial future is continually uncertain and indefinite, which makes long-time policies impossible and extension service difficult. Although handicapped by low salaries or by no salaries for the volunteer workers, by short opening hours, and a small book supply, they accomplish much good in rural sections. A number of such struggling libraries are keeping lighted the torch of learning, waiting for some civil unit to assume the responsibility.

PUBLIC LIBRARY, CLINTON, KY.

Hickman County Library is the name of the library at Clinton, Ky., although neither the county nor the town gives financial assistance. It is so named in order to encourage its use by farm people. Its use is not only free to all the county, but country people are encouraged to use it and do use it. It is the only library in this county of 10,244 population. It is the only place in the county where books can be obtained, as there is no bookstore in the county. Agriculture is the universal occupation. One of the chief aims of this library is to help wipe out the considerable amount of illiteracy in the county.

The women's club, composed of 50 women, mostly wives of farmers, is the motivating force, and title to the institution is vested in it, but the library is a popular public institution supported by both town and country people who are carrying out a county-wide community enterprise. The library originated in 1916 from a "book shower," which brought 60 books and $25. From year to year other similar entertainments and gifts brought more books. Two men provided shelter for the collection for a few years, and later a store was rented. In January, 1925, a house in a central location was bought for $2,700 to be used as a library. The plan called for the removal of the building in later years and the erection of a library building. Two men were persuaded to buy the building and lot, for which $700 was paid down by the women's club from a fund which had been gradually accumulated for this purpose from receipts from entertainments. Notes which bore 6 per cent interest were given for the remainder. The building was reconstructed, and water was put in at a cost of $600. This was financed by receipts from entertainments and by public donations, in all of which country people played a part. Some money remaining from a war-time fund was used, and material and labor were donated.

The building has a book room, a reference room, a museum, an equipped kitchen, a hall room, and an assembly room (with movable chairs) which is used also as a reading room.

There are 2,475 volumes in the library. The circulation was 3,092 books in 1926, and 1,102 people were registered as borrowers, of whom one-half lived outside this town of 1,455 population. Town and country schools obtain their reference material from the library.

The museum, given by a local woman citizen, consists of such exhibits as Civil War, World War, and Indian relics, minerals, shells, ship models, and old newspapers of historical value, all of which are labeled.

The library is in charge of a board of five members who appoint the librarian. The expense of maintaining the library from June 5, 1925, to June 5, 1926, was $1,262.86, which included expenses of reconstructing the new building. The important ordinary annual expenses are librarian's salary, $144; janitor's salary, $60; interest, $120; insurance, $15; fuel, $15; water and light, $26; and new books, $60. These expenses are met regularly by various kinds of local entertainments participated in by town and country women.

The women are undaunted by the $2,000 debt. They regard it as a stimulus. They know that continued work, more community effort, and mutual aid by town and country people will eventually wipe it out. It must be liquidated, for they see in the future a new library building on the same spot. They also see illiteracy wiped out, rural book-hunger satisfied, children's mental wants supplied, a higher level of general intelligence, and better town and country cooperation.

COUNTY LIBRARIES

A recent development is the county library. The first county free libraries were established in 1898 in Van Wert County, Ohio, and Washington County, Md., as original county libraries, and in Hamilton County, Ohio, through extension of the privileges of the Cincinnati Public Library to the people of the county. Two-thirds of the States have passed laws permitting the establishment of such libraries. Two hundred and forty-five counties are financing some form of county service. Since the State law was passed in 1920 the people of one-third of the 21 counties of New Jersey have voted to establish county-tax libraries, which are now in successful operation. Of the 58 counties in California, 46 have county libraries. Two counties, Mariposa and Plumas, have recently contracted with the neighboring counties of Merced and Sierra for library service.

The county library is a central free library for the whole county with more or less extensive and changing collections of books established throughout the county in the form of branches (fig. 7) or station libraries or school collections. Books are transported from the central library to these branch or station libraries near the people to be served (fig. 8) or to the people direct by book automobile, by mail, or by other mode of transportation.

The central library is open to all, and individual book service is available by mail. The central library may be a newly established one, or the county may contract for county service with an existing city or neighboring county library. It is established by vote of the people or their representatives, the county governing body, and is maintained by a small tax or money voted from the county fund. It may be a gift to the county. It is governed by the county board or by a library board appointed by the county board and is operated by a librarian who is trained in a library school and who is assisted by a competent staff, some of whom make frequent visits to the country branches. Existing libraries usually may come into the system or remain independent.

County libraries are now circulating not only books and periodicals but phonograph records, pictures, films, lantern slides, sheet music, stereographs and charts, globes, and supplementary school material.

SUTTER COUNTY FREE PUBLIC LIBRARY, YUBA CITY, CALIF.

Sutter County is purely agricultural and has no factories. It has a population of 10,115, and an area of 608 square miles. Most of the Yuba City population of 1,708 are connected with agriculture. Previous to 1917 there was no public library in the county. Various local groups who felt the need of a library sent to the State library for a library organizer, and it was decided to take advantage of the State county free-library law. Petitions were circulated and signed requesting the county board of supervisors to establish such a library. After giving two public notices of intention in newspapers, the supervisors voted, in 1917, to establish a separate county library including the whole county for library and tax service, and voted a 0.35 mill tax for maintenance, which produced $4,342. This tax was later raised to 0.4 mill and then to 0.5 mill.

FIG. 7.—This library sign points the way to the farmhouse among the trees where a library station of the San Joaquin County (Calif.) Free Library is maintained for the benefit of the farming community of Orchard

The library has a central location in Mission Hall, a building purchased by the county. The library occupies two-thirds of the space, about 2,400 square feet, and the farm advisor, the horticultural commissioner, and the justice of the peace together occupy the other third.

Forty-one distributing points for books have been established in the county. These include 12 community branches located in stores, post offices, farm homes, and clubhouses (3 with reading rooms), and 29 collections located in schools. Collections of 250 to 1,500 changeable books are sent to branches. Pictures are sent, and phonograph records for use at public meetings. Most branch quarters are provided locally, and the custodians, who are usually postmasters, storekeepers, or farmer's wives, receive from $5 to $25 monthly from the county.

All the 35 public schools in the county are furnished supplementary material, from 100 to 1,000 books each, with maps, globes, charts, music records, desk and wall pictures, stereographs, etc., selected by the teacher. Mailing expense is carried by the county library. If there is no community branch at the place, a set of 20 library books for adults, changeable monthly, is placed in charge of the teacher, with transportation at county-library expense. For individual farmers who are distant from branches and schools, packages of one to four books are mailed when requested. A single book is mailed to anyone on special request. Program material, statistical data, and speakers are furnished to study clubs, farm bureaus, and other organizations. The library moving-picture machine is also loaned. All county people may use the main library direct.

To encourage good reading by children, the county librarian gives lectures and demonstrations as to the use of library books in schools and issues certificates to pupils who have read six books a year based on a county list. Story-telling hours for children are held once a month in each school by the county librarian, and children's book week is celebrated annually in every library.

FIG. 8.—This Italian farm girl secures Americanization books for the family from the Orchard Library Station of the San Joaquin County (Calif.) Free Library located in this farm home

For the year ended June 30, 1926, there were 37,844 bound volumes in the library and 4,923 borrowers, an increase of 881 borrowers during the year. Over 2,000 borrowers are from the country. During the year 66,290 books and periodicals were circulated from the library and branches, an increase of 12,000. Community-branch circulation was 27,498. Besides this circulation, the schools used 14,173 supplementary books, bringing the total to over 80,000. One thousand eight hundred and thirty-five shipments were made to and received from the 41 distributing points by the main library. The packages contained 16,731 items, composed of books, maps, charts, music records, etc. The county furnishes the librarian with an automobile for use three days a week, and 221 visits were made to branches and schools during that year, at which time books were delivered and other books were returned. Advice and assistance were given to branch librarians and patrons.

The following is a statement of the library material supplied by the library to the schools of Sutter County for the academic year ended June 30, 1926:

Supplementaries	14,173
Home reading	2,074
Maps	130
Music records	123
Magazines	190
Stereoscopes	7
Stereographs	2,071
Pictures	12
Globes	13
Encyclopedias, sets	12
Dictionaries, large	21
Charts	135
Total number of books in schools	16,391

Value of material supplied that year	$14,149.16
Value of material that remained from the previous year	4,720.16
Total value of material used by schools that year	18,869.32

Amount of money turned over by school districts to county free-library fund for the year:	
Elementary	3,150.00
High	506.73
Total [3]	3,656.73

The above figures do not include books for outside reading or transportation charges.

Financial statement of Sutter County, Calif., Library, July 1, 1925, to June 30, 1926

Expenditures:	
Books	$7,141.56
Maps	341.76
Periodicals	505.25
Pictures	4.47
Music	44.40
Binding	345.25
Printing	50.50
Supplies	244.86
Salaries (headquarters, including head librarian)	4,638.15
Salaries (branch librarians)	1,040.00
Furniture (headquarters)	322.00
Furniture (branches)	98.60
Heat for branches	4.00
Express, freight, postage	309.95
Telephone	53.65
Traveling expense (general)	5.00
Traveling expense (branches)	4.60
Miscellaneous	16.80
	15,170.80
Receipts:	
Unexpended balance	9,282.98
Local taxation (being 0.5 mill)	8,808.44
Salary fund	1,833.15

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[3] According to State law, each school library is allowed not to exceed $50 yearly. This county allows $50.

Receipts—Continued.	
Schools (high)	$375.55
Schools (elementary)	3,450.00
Fines and lost books	152.10
Refund	19.20
Total receipts	23,921.42
Total expenditures	15,170.80
Balance	8,750.62

FINANCIAL STATEMENT OF SCHOOL SERVICE

Receipts		$6.925.31
Balance June 30, 1925	$3,099.76	
Apportionment (elementary)	3,450.00	
Apportionment (high)	375.55	
Total	6,925.31	
Expenditures		3,740.80
Books (supplementaries)	3,036.12	
Maps	341.76	
Periodicals	243.50	
Pictures	4.47	
Music	44.40	
Teachers' library	52.15	
Miscellaneous	18.40	
Total	3,740.80	
Balance		3,184.51

The assessed valuation of the county, taxable for county purposes, is $18,084,190.

The county librarian is appointed by the county supervisors on certification of qualification by the State board of library examiners, and she has three assistants. The library is under the general supervision of the county supervisors, but no library board stands between librarian and supervisors; this gives the librarian much responsibility. The county farm advisor cooperates with the librarian in obtaining technical information and general reading for farm people.

Live Oak community branch library.—The Live Oak community branch library is located in a village of 289 population in a rice-growing territory 12 miles from Yuba City. It has a library-serving radius of 4 miles. (Fig. 9.) The statistics for 1926 were as follows: Books, 2,000; borrowers, 563 (the majority were farmers); circulation, 7,761. The library is open three afternoons and evenings weekly. The quarters are supplied by the community, but the librarian's salary ($25 monthly) and the furniture in the library are supplied by the county. The records were well kept. The branch librarian makes monthly reports to the county librarian. The building is the property of the women's club; it cost $5,000 and was financed by fairs and entertainments. It is used in general for community affairs, but two rooms are set aside for the use of the library. A club woman is librarian. The school appropriation is $350 a year, and the value of supplementary material received for the school is $1.637.58.

The county library makes its available material known to those who need it in many ways. One is its monthly mimeographed publication called "Library Chat." This publication, which contains book reviews and other notes, goes to every branch and school librarian. Other devices include an annual display of new children's books; new book lists and reviews made public each week for which newspaper reporters call; special articles furnished to newspapers; library exhibits shown at county fairs, farm bureau picnics, stores, and in the main library; talks given at schools and at farm bureau and other meetings; book reviews given before clubs; organization of "reading with a purpose" courses; and visits through the county made by the librarian and her assistants.

The following letters indicate the value of library service to the schools:

During the three years that I have acted as principal of the Live Oak Grammar School we have made many requests of the county library. All of them have been filled. The service has been prompt. We have been liberal about expressing our needs. We have asked for and we have received many things that we could not have afforded to purchase for ourselves if the expenditure of our part of the library fund had been under our own control. By a careful and systematic plan of shifting the supplementary books from one school to another in the county a great deal of money is saved; for in this way not nearly as many copies of each book are required to equip schools, yet every school is assured of having the correct number when they are needed. (Signed) George W. Fellows, Principal, Live Oak Grammar School.

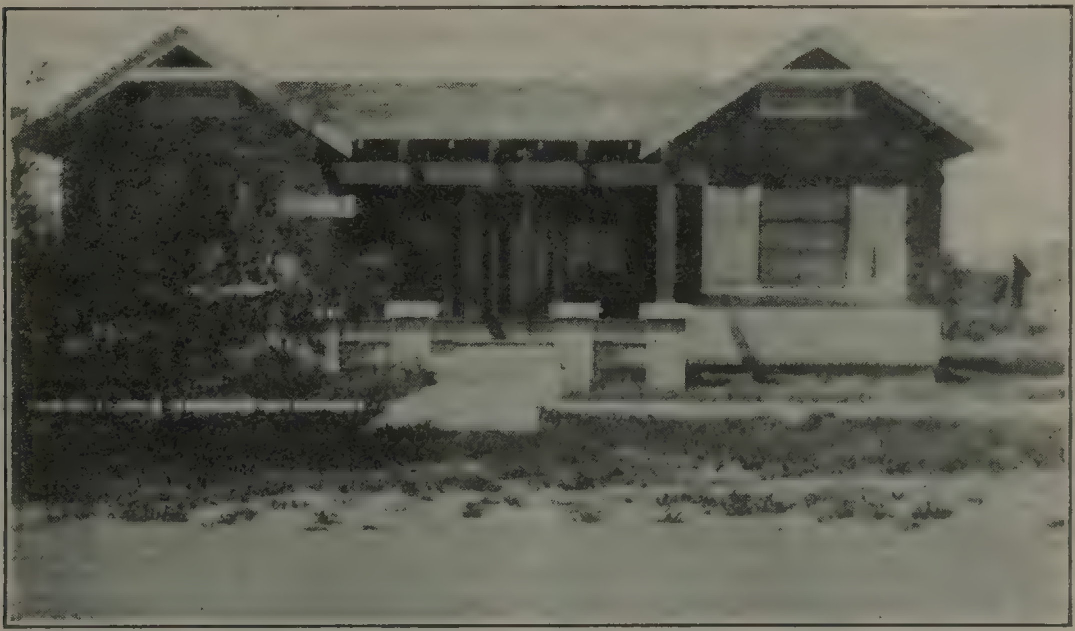

FIG. 9.—Live Oak rural branch of the Sutter County (Calif.) Library

May I express appreciation of the splendid work the county libraries are doing? I have been surprised to find in many instances that the service rendered by the county libraries to the various districts has brought a return to the cooperating districts more than six times greater than the return that could have been secured if the library fund had been expended by the individual districts. (Signed) Will C. Wood, Superintendent of Public Instruction (State).

The following is a reply by the Sutter County board of supervisors to the request of the supervisors of another county as to the success of Sutter County Library:

The county free library has filled a long felt want in this county, and has reached out into every portion of the country and given a thorough and efficient service to the whole county. In the opinion of the board no one thing that this board has done has contributed more to the welfare and education of this county than has the county free library, and we believe that its cost to the county is far out-weighed by the benefit that it has done to the county as a whole. By order of the Board of Supervisors, F. H. Graves, Chairman.

MONMOUTH COUNTY LIBRARY, FREEHOLD, N. J.

Strongly supported by the county board of agriculture, the grange, and the county agent, the Monmouth County Library was established in 1923 by the county board of freeholders after a favorable majority vote of the people of the county. It serves approximately 51,000 people, according to the 1920 census. Eleven towns and one township, which support local public libraries, have not as yet elected to enter the county library system, as permitted by the county library law. There are branches of the county library in five towns which have libraries of their own; thus several towns pay two library taxes through choice. A tax rate of 0.2 mill was voted which provided $20,770 in 1926 for maintenance of the library; $1,280 was also received from the State based on service to schools; $12,341.71 was expended for books and $9,098.31 for salaries.

The library not only lends books from the main library direct to country people but also lends through 135 local distributing centers called library stations, 24 of which were established in 1926. These library stations are located as follows: 12 in stores; 24 in homes (mostly homes of farmers); 5 in existing libraries; 3 in post offices; 8 in borough halls; 1 in a chapel; 1 in a road stand; 1 in a parish house; 1 in a women's clubhouse; 2 in Young Men's Christian Association buildings; 5 in grange halls; 2 in community houses; 2 in churches; 1 in a summer camp; 1 in a fire-engine house; 2 in high-school libraries; 18 in schools circulating books to adults and children; and 46 in schools circulating books to children. Farm and club women, grange officials, storekeepers, postmasters, borough officials, ministers, and teachers serve as local custodians or librarians. From 50 to 1,000 books are kept at the stations, changeable at the bimonthly visit of the county librarian or more frequently by mail.

The main library, located in the courthouse, had 36,557 books on its records in 1926, a gain of 6,501 during the year. About 3,000 books are kept in the main library; the rest are in circulation to individuals or at country library stations or in transport from station to station, the object being to have the books where needed when needed. The 135 stations and the central library had an estimated circulation of 411,268 books. The number of books loaned to individuals from the local stations exceeded the number loaned the previous year by over 10,000. The main library and the stations have 9,847 registered borrowers.

The library has a book automobile made from the chassis of a 1-ton truck, with a specially constructed inclosed body, having shelves which hold 800 books and boxes for phonograph records and for pictures. The librarian uses this in transferring books from the library to country stations and return, covering each station at least once every two months by one of 25 automobile routes on each of which are from two to six stations. Books exchanged at the stations are selected by the local custodian with the advice of the county librarian. The car made 515 deliveries of 35,183 books to stations in 1925. In addition, 1,944 mail shipments of 4,993 books were made to stations on rush requests, and 451 books were mailed on request to persons far from stations. Nine thousand and fifty-seven books were borrowed by country people direct from the main library. Phonograph records and pictures are circulated widely. All schools receive reference books from the main library, the total number used being 5.517. To fill requests for books not in stock, 539 books were borrowed from other libraries in the State.

The library is under the supervision of a county library commission of five members appointed by the county board of freeholders. The commission appoints the librarian and the five assistants, the latter on the recommendation of the librarian. Office work is performed largely by the assistants, the librarian being generally in the field transporting books, conducting story hours for children, or consulting and advising station custodians on book needs and other community matters. Each station has its own library board. Library quarters are furnished and incidental expenses are provided for locally.

To acquaint the people of the county with the book service offered by the library the following methods are used: The librarian has joined the grange in order to have direct contact with farmers and to learn their needs. Library talks are given at meetings of the grange, the Young Men's Christian Association, women's clubs, schools, and other organizations. Newspapers are supplied with articles on library availability, with lists of new books, lists of special books for special purposes, etc. Effective use is made of the book automobile with its conspicuous sign, "County Library." Special-request deliveries are made to remote places. "People see, stare, ask questions, borrow books."

Library exhibits are made especially at the annual five-day county farm bureau meeting. The exhibit usually consists of agricultural books. books for farm women and children, maps showing the location of library stations, charts, etc. Book lists are distributed, and talks are made on the use of the library. Effective use is made of the library camera. Children's book week is celebrated. Cooperation is maintained with other agencies including work with the county health office, the parent-teacher association, the Boy Scouts of America, the Young Men's Christian Association, the county board of agriculture, the county social service organization, school boards, women's clubs, mission-study classes, the grange, the farm bureau, churches, and schools. The county agent is an effective instrumentality in advertising the library, for he makes known to the librarian the particular farm books that are needed and fills requests of farmers for delivery of particular books.

The library recognizes its mission to farm people, and particular efforts are made to serve them. When a farmer requested a trade book which was not in the library, requests were made by the librarian to six other libraries, to the State library, and to a publisher without success. Finally the secretary of the State library commission borrowed a private copy and sent it. A farm boy with little chance for schooling was loaned a book on stationary engineering. He studied it during the winter, passed an examination for stationary engineer, and secured a good position. A sheep herder who borrowed a book on animal diseases when his sheep became sick saved his sheep, while other flocks perished. When the potato crop failed and diversification became necessary the library was ready with truck-garden, fruit, dairy, and poultry books which were greatly appreciated. Not only trade books but the classics and modern fiction are in demand by farm people. Western stories are especially popular. Opposition to the establishment of a county library was voiced by some farmers on the theory that books would never reach the farmers, but these farmers are now among the most frequent users of the library.

Tinton Falls Library Station.—There are about 40 families in the farm community of Tinton Falls, 14 miles from Freehold, but there is no post office. A library of 200 volumes is maintained in a farm home with the housekeeper as custodian. Books are changed bimonthly by the book automobile. The library is open two days a week, but borrowers come at all times. About 40 books are circulated every month; each loan is for 28 days, and the loan can then be renewed, but several people read each book taken out. Registered borrowers in 1926 numbered 84. The county library sent 435 books in 1926 in 6 shipments, and 9 were mailed at special request. The school also received 60 books.

COOKE COUNTY LIBRARY, GAINESVILLE, TEX.

A Cooke County farm woman who was managing her own farm is credited with responsibility for the Texas law which permits counties to establish libraries. A number of successful county libraries are now functioning under this law. She became librarian of the Gainesville Public Library and outlined the plans for the library building given the city by the Carnegie Corporation of New York. She went to California at her own expense to study the county-library system in successful operation and was responsible for the fact that Cooke County established a county library. After it was established she was responsible for merging the Gainesville Public Library with it. She never forgot her farm origin, and her actions were based on rural needs as she had experienced them. As she stated: "My country breeding and love for books received a severe shock when I found there was no legal way in which rural people could organize and support a public library for themselves."

Soon after becoming county librarian she established, on request, 25 community branch libraries and 54 school station libraries, which were the first public libraries in the county outside the county seat. The first branch was established in the isolated community where she was born, 20 miles from Gainesville. During one year 2,500 books were circulated to 199 readers in this community which had never cast more than 90 votes in an election.

The county free library was established by the commissioner's court on the signed petition of 1,361 voters outside of Gainesville—a majority of such voters. As the county established a separate library instead of contracting for county service from the Gainesville Public Library, the latter institution was merged with the county library by the city council, becoming the central office of the county library and a branch of that institution. A simple contract was signed to protect the rights of both parties.

The Carnegie building, all city library property, and the $1,500 maintenance guarantee, made to secure the Carnegie building, were turned over to the county. The county agreed to spend immediately $1,000 for books and at least $50 monthly thereafter, and to pay the librarian's salary. Upon the termination of the contract, all city property and one-third of all books purchased subsequent to the contract were to revert to the city. The total property has an estimated value of $37,772. The contract has been beneficial to both parties, but the greatest benefit is claimed to be that of learning the advantages of town and country cooperation and of equal service to all, and the realization by country people that the town is willing to venture and share with them.

Cooke County, an agricultural county joining Oklahoma, has an area of 902 square miles and a population of 25,667, the Gainesville population being 8,648. The library was opened in January, 1921, and the first branch was opened in March, 1921. The county gives $3,500 and the city $1,500 for library support. The library is controlled by the commissioner's court and managed by the county librarian, with one full-time and one part-time assistant.

According to the 1925 report there were 13,044 books, 3,917 pamphlets, and 184 periodicals in the library. The number of books in branches at the beginning of the year was 4,082; sent to branches 3,388, returned 2,280; books loaned to branches, 7,470. Central-library circulation of books, periodicals, bulletins, etc., was 25,554; branches, 17,930; schools, 4,106; the total county circulation was 47,590.

The circulation gain was 1,002 for the main library; 1,010 for the branches, and 2,023 for the schools. There were 1,363 books sent to school stations, and the school-station circulation was 4,106. There were 2,863 borrower's cards in the main library and 2,448 in the branches, not including schools. Each rural borrower's card represents several readers. During the year 65 visits were made to branches and 18 to schools. Professional visits of teachers to the main library numbered 268. Branches are located in homes, stores, etc., the community furnishing the quarters and custodians. Books are transported to and from branches voluntarily by persons who are going back and forth, and by the county librarian who goes in her own car five or six days each month, the county allowing $120 for traveling expenses. Circulation statistics for the branches are as follows:

Bloomfield.—Books sent from main library 78, returned 39, on hand 166; circulation 568; new readers 0, total readers 70; population[4] 47.

Bulcher.—Books sent 79, returned 39, on hand 199; circulation 544; new readers 12, total 91; population 40.

Callisburg.—Books sent 135, returned 80, on hand 201; circulation 1022; new readers 32, total 258; population 110.

Concord.—Books sent 169, returned 134, on hand 179; circulation 1449; new readers 42, total 148.

Delaware.—Books sent 76, returned 30, on hand 183; circulation 556; new readers 6, total 58.

Dexter.—Books sent 95, returned 25, on hand 221; circulation 1611; new readers 17, total 135; population 317.

Dye.—Books sent 271, returned 287, on hand 43; circulation 603; new readers 0, total 59.

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[4] It has not been possible to determine the population in those cases in which the population is not given here.

Era.—Books sent 190, returned 126, on hand 267; circulation 790; new readers 21, total 206; population 263.

Hemming.—Books sent 72, returned 75, on hand 151; circulation 284; new readers 0, total 98.

Hood.—Books sent 196, returned 104, on hand 230; circulation 574; new readers 37, total 219; population 265.

Hays.—Books sent 32, returned 51, on hand 122; circulation 266; new readers 12, total 82.

Lemons.—Books sent 134, returned 0, on hand 134; circulation 187; readers 37.

Lindsay.—Books sent 27, returned 46, on hand 241; circulation 343; new readers 0, total 79; population 140.

Maryville.—Books sent 175, returned 189, on hand 169; circulation 487; new readers 41, total 174; population 162.

Mossville.—Books sent 171, returned 21, on hand 160; circulation 367; new readers 9, total 73; population 42.

Myra.—Books sent 271, returned 209, on hand 271; circulation 1877; new readers 26, total 251; population 417.

Negro.—Books sent 116, returned 1, on hand 298; circulation 1210; new readers 113, total 157.

Rosston.—Books sent 10, returned 0, on hand 173; circulation 205; new readers 0, total 137; population 330.

Salem.—Books sent 192, returned 186, on hand 150; circulation 551; new readers 7, total 99.

Sivells Bend.—Books sent 165, returned 160, on hand 308; circulation 1626; new readers 16, total 245; population 79.

Tipton.—Books sent 91, returned 62, on hand 91; circulation 243; new readers 18, total 18.

Tyler's Bluff.—Books sent 64, returned 51, on hand 93; circulation 238; new readers 0, total 58.

Valley View.—Books sent 411, returned 45, on hand 355; circulation 826; new readers 56, total 553; population 762.

Warren's Bend.—Books sent 62, returned 110, on hand 99; circulation 144; new readers 2, total 69.

Woodbine.—Books sent 132, returned 17, on hand 229; circulation 1072; new readers 21, total 226; population 113.

Total financial receipts of the county library for the year were $5,268; expenses, $5,180.42. The county tax valuation is $16,350,000.

The main library building, located in the heart of the city, is of brick and has one story and a basement. It includes an auditorium, a clubroom, and a museum. The material for the museum was collected by the librarian and consists of 13 shelves of fossils, Indian relics, early implements and arms, local history books, and manuscripts—a total of 262 articles.

County people are kept in touch with what the library has that is of use to them by talks made by the librarian to clubs and schools (five or six each month), by monthly reports, and by new book lists in country newspapers; by conversation with the county librarian during official visits; and by library exhibits at State, county, and local fairs.

Valley View branch library.—A farm girl who has completed the local two-year high-school course has been in charge of the Valley View branch library of 400 volumes, which is located 12 miles from Gainesville, during the five years of its existence. The library occupies a prominent place on the balcony of a general store and is open two afternoons a week. The county librarian brings books every few months, and special-request books arrive by mail. The class of books used is similar to those of any standard small library, but many school reference books are always included and are much used. Over 500 people, half of them farmers, registered as borrowers in 1925. Citizens traveling to the county seat exchange the much-read books. The women's improvement club, which includes farm women, has charge of the library and is responsible for the 50-cent per afternoon salary of the librarian, which is about the only library expense.

Citizens, including farmers, expressed great satisfaction at having a free library of up-to-date changing books, especially since without the county library they would be 12 miles from any library.

As to the success of the county library the county superintendent of schools said:

> It is working well for the county and is especially helpful to the schools. According to law all State-aid schools must furnish $10 worth of fresh books per room per year. We get the books from the county and receive more and better books. We know the county system is a good system.

JACKSON COUNTY LIBRARY, MEDFORD, OREG.

"The county library brings books to the boy on the farm." This slogan was responsible for the establishment of the Jackson County Library. With a side reference to Abraham Lincoln the slogan carried the day in the petition to the county court in the campaign of the county people for equality of library privileges.

Two petitions were circulated, one for taxpayers and one for nontaxpaying voters. Both were simple and advocated 0.2 mill tax for maintenance and included the actual amounts that the tax would raise on assessments of $1,000, $5,000, and $10,000, respectively. The county court voted the 0.2 mill tax, $5,000, and entered into a contract with the existing Medford Public Library to extend its service to rural people by the purchase of additional books, by opening its doors to country people, and by the establishment of rural branch and school station libraries.

The county has an area of 2,794 square miles and a population of 20,405. The library is not located at the county seat town which is smaller and less accessible than Medford, which has a population of 5,736. Ashland, with a population of 4,283, located 16 miles from Medford, remains outside the county-library system in accordance with the State county-library law which permits cities of over 4,000 population that give over $2,000 annual support to an existing library to so elect. (Fig. 10.)

Throughout the county there have been established 9 branch libraries, 26 deposit stations, and 80 book collections in schools. Branch libraries are permanent in nature. Some of these towns had had small libraries previously and have local library boards. Library headquarters and small stipends for librarians are provided locally, usually by women's clubs from receipts from entertainments. The county pays $5 per month to some of the librarians to encourage responsibility. From 400 to 500 books, changeable yearly or sooner if requested, are sent to these branches. The 20 library stations are all in farm homes for community use. Fifty books are sent to each, changeable trimonthly. Books for children are sent to the 80 schools, 25 books at a time, changeable trimonthly or oftener if wished. Twice a week a trained assistant goes to one of these schools, each in turn, to instruct teachers and children in the care and use of books and to hold story hours to encourage good reading. Tabulations for

36 schools revealed that 5,514 books had been read in one year. Black Beauty had been the most popular book.

All mail shipments of books are paid for by the county library. Direct mail service of books also is given to any resident of the county upon request; the county library pays the postage.

On January 1, 1927, there were in the library 12,590 books owned by the city and 8,324 owned by the county, an increase during the year of 974 and 1,783, respectively. Newspapers and magazines in the library totaled, respectively, 172 and 134. In 1926 the central library reported a circulation of 87,423 books, the branches 43,327, stations 2.548, and schools, 7,306. The total reported circulation was 140,604. Children's books circulated from the central library totaled 28,452. Special books borrowed from the State library and circulated numbered 937. Per capita circulation in Medford (1926 population estimate) was 9.9 books; circulation per capita outside Medford and Ashland was 3 books; county circulation, including circulation in Medford, 6.7 books. Thirty-eight per cent of the people outside of Medford and Ashland are reported to be borrowers of county library books. The number of borrowers' cards in force January 1, 1927, was as follows: City, 5,181; county, 1,437; total, 6,618.

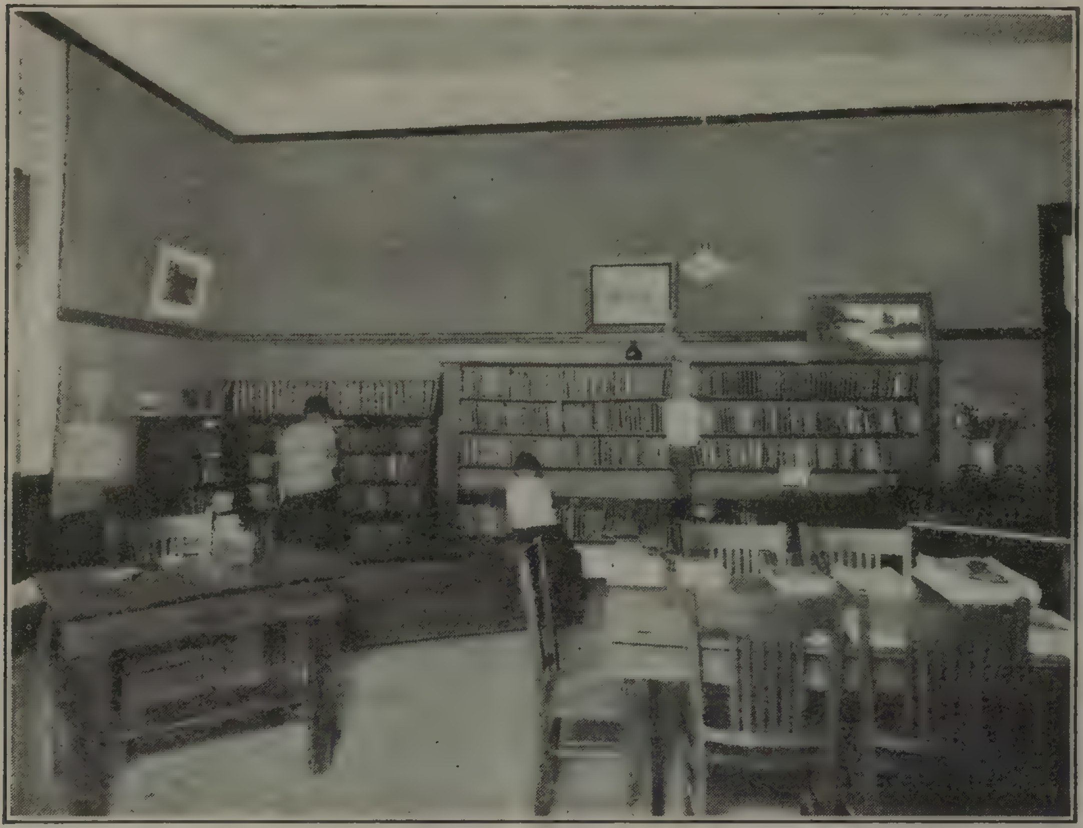

FIG. 10.—Branch of the Jackson County (Oreg.) Free Library, located at Talent; population, 278

The library has a good collection of public documents, including many farmers' bulletins. These are well arranged by subjects in numerical order. Much effort is exerted by the librarian and the county agent to inform farmers of publications available for particular needs and to extend their use. When questioned concerning the attitude of numerous librarians who have said that, on account of difficulty of handling bulletins, they preferred to let the county agent take care of agricultural bulletins, the librarian replied that while she wanted the assistance of the county agent, she saw in such work a great field for usefulness open to the library, that she recognized her duty, and that she welcomed the opportunity to perform it.

Financial statement of Jackson County (Oreg.) Free Library, January 1, 1926, to December 31, 1926

	City funds	County funds
Receipts:		
Balance Jan. 1, 1926	$3. 445. 83	[5] $4, 418. 01
Tax receipts	7, 681. 61	5, 236. 50
Desk receipts	696. 04	--------
Total	11, 823. 48	9, 654. 51
Expenditures:		
Books	1, 857. 25	2, 581. 49
Periodicals and indexes	345. 35	368. 53
Salaries	3, 489. 70	3, 045. 79
Janitor	511. 40	--------
Heat	120. 00	--------
Light	110. 84	--------
Water	39. 00	--------
Telephone	64. 25	--------
Repairs and improvements	647. 96	--------
Furniture and fixtures	389. 99	--------
Insurance	145. 87	--------
Binding	227. 55	201. 15
Printing and supplies	313. 85	159. 22
Shipping supplies	--------	2. 20
Postage, freight, express	64. 03	58. 39
Current expense	210. 00	350. 00
Total	8, 537. 04	6, 766. 77
Balance on hand Dec. 31, 1926	3. 286. 44	2, 887. 74

Cost per capita in Medford, $0.83; in county, including Medford, $0.24.

Medford Public Library, with which the county contracts for service, is governed by a library board appointed by the mayor. The county superintendent is an ex officio member. It is administered by a staff of six, consisting of the librarian and the first assistant librarian (trained), two clerks, a stenographer, and a part-time cataloguer. One-half of the salaries of the two trained librarians and one clerk, and all of the salaries of the stenographer and the part-time cataloguer, are paid by the county. The remainder of these salaries and the wages of a page and a janitor are paid by the city.

The library building was provided for the city by the Carnegie Corporation of New York. It is located in the heart of the city on extensive improved grounds furnished by the city. (See fig. 1, p. 2.)

Constant efforts are made by the librarians to keep in touch with the book needs of the country people and to advise them of available assistance. Methods used include: (1) Library exhibits at all fairs; (2) publication in county papers of book news and items of special interest; (3) distributing new book lists over the country; (4) talks given at club meetings; (5) annual celebration of children's book week, including extensive advertisement by means of book posters; and (6) publication and distribution to rural people and county branches of special library pamphlets.

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[5] Taxes are not paid until Apr. 1, which accounts for Jan. 1 balance from previous year.

One of these pamphlets entitled "Procedure for Branch Librarians," in addition to instruction in technical details, emphasizes the desirability of neatness, attractiveness, good order, and discipline in branches and closes with a call to all librarians to familiarize themselves with the contents of books, to anticipate the needs of borrowers, and to offer each something that will give pleasure, broaden experience, or solve difficulties.

Central Point Branch Library.—The village of Central Point has a population of 582 and is situated in an orchard district 5 miles from Medford. It had never had a library previous to the establishment of the branch in 1920. There are 400 county books, and 250 books have been donated locally. Fifty county books are changed each month, the branch paying expenses one way. Borrowers in 1925 numbered 502. The circulation was 6,500 books. The library was open two afternoons and evenings weekly. The librarian received $10 per month salary, $5 furnished by the county and the remainder by local organizations, including a farm women's club. The village government furnished only the library room, fuel, and lights. The people seemed well satisfied with the library service, especially considering that it had no financial support from the town government. The librarian believed that without this branch the people would not have had a library.

The following is a digest of the contract between the county of Jackson, Oreg., and the library board of Medford, Jackson County, Oreg.:

> * * * Whereas, the County Court of Jackson County, Oregon, has levied a tax of two-tenths of a mill for library purposes and deems it advisable to contract with the Public Library of Medford, Oregon, for the use * * * by the Library Board of said library fund to the purposes specified in Chapter 357 of the General Laws of Oregon for 1919: * * * The Library Board deems it advisable to extend the use of the library of Medford to the residents of Jackson County * * * and for that purpose * * * to contract with the County of Jackson for the use by the Library Board of the library fund created by the tax levied by the County Court of Jackson County. * * * It is * * * agreed * * * that the City of Medford shall maintain a library building, and the library board shall operate * * * the Public Library of Medford for the free use of the inhabitants of the County of Jackson; saving and excepting as to such cities as shall elect not to come under the provisions of said Act * * * That the County shall pay by warrant, as provided in * * * properly certified bills of the Library Board to the full amount of the moneys in the library fund of said County, provided however, that such payments shall be made only for books and periodicals which become the property of the County, and the services of a trained librarian and the necessary assistants for County service, and for necessary transportation and traveling expenses, including postage and telephone, in maintaining the County system * * * That the Library Board agrees to establish a system of branches, deposit stations, and travelling libraries, and individual service, upon request, with free transportation, except within incorporated cities where a deposit of books is maintained, and to provide books and supervision in such communities of the County outside the City of Medford as will agree to maintain any such branch, deposit station, or travelling library * * * That all books belonging to the Public Library of Medford, Oregon, shall be * * * free to all residents of the County to be used for lending and deposit in branch libraries and other libraries participating in the County Library service, on the same terms provided for books bought with County funds. That any city library

within the County of Jackson, State of Oregon, already established shall, upon request, be furnished with a deposit of books proportionate to the share of such County library tax paid by such city * * * or with any larger deposit as shall be equitable and just, as may be agreed between the County Court and Library Board. The Library Board shall on or before the first day of January of each year submit upon request of either body a report to the County Court of Jackson County, Oregon, and to the Trustees of the State Library, stating the condition of their trust; the various sums of money received from the library funds and all other sources.

COAHOMA COUNTY LIBRARY, CLARKSDALE, MISS.

An old tenant-farm woman came into the library at Clarksdale, Miss., with a dozen chickens to sell, thinking the library was a hotel. She was a widow who was making a scanty living for herself and four children by working in the fields on a small farm 10 miles out. One child, home from school because of sickness, had asked her to buy a book. The mother didn't know what a library was, but had intended to buy the book at a store if there should be any money left after buying necessities. The librarian believed that library books should be in the hands of those who needed them. The result was that the surprised old farm woman went home with a half dozen books and, shortly after, a library station was established near her farm, to which the county librarian came once a month in the library book automobile bringing new books, taking back used ones, and consulting and advising with the farm people about their book and other needs.

The Clarksdale Public Library began in 1914, when the Carnegie Corporation of New York gave $10,000 for a building, the city of Clarksdale (population 7,552) agreeing to furnish the site and $1,000 yearly for maintenance. The site cost $10,000. Many farmers, the women's club, and others, gave books to the library which was opened to all the people of the county. The county department was established in 1917 in accordance with a special State law for this county which allowed it to give $500 for books for the Clarksdale library, which sum was given for two years by the county supervisors. A later State law permitted $3,000, which was given, and in 1926 another special law permitted $7,500 for maintenance of the Clarksdale Library. The county voted $4,000 for 1927. (Fig. 11.)

Library extension service for this county of 530 square miles area and 41,511 population really began in 1922 when country teachers came into take out packages of books for country people, and 2,936 books were circulated that year. In 1923 the library bought an old automobile from the city, reconstructed it as a book automobile, and in September began carrying books to county library branches, school stations, and direct to people. For the last four months of 1923, 3,542 books were carried; in 1924, 10,457, and in 1925, 13,050. In 1926 a new book automobile was placed in use. A touring car chassis was bought and reconstructed, and shelving was added for 600 books. The total cost was $603. The reconstruction work was done by the manual-training class of the county colored agricultural school. This book automobile is in charge of the librarian for county work who carries books to some of the country stations and schools three days each week. The cost of operating the truck in 1924 was $164.44. Supplementary books, maps, magazines, etc., are furnished to all schools, and nonschool books for pupils or parents are supplied to some of them.

There are over 40,000 volumes in the library. The total number of books issued from the main library in 1926 was 56,263. The circulation from county stations was 18,815, an increase of 4,029 over that during the previous year. At the end of the year there were 3,360 books at county stations. During the year 12,080 books were sent to country stations by book automobile for circulation. Country patrons also took 12,500 books from the main library. There were 29 public library stations in the country in operation at the end of the year, located in stores, offices, community houses, and schools.

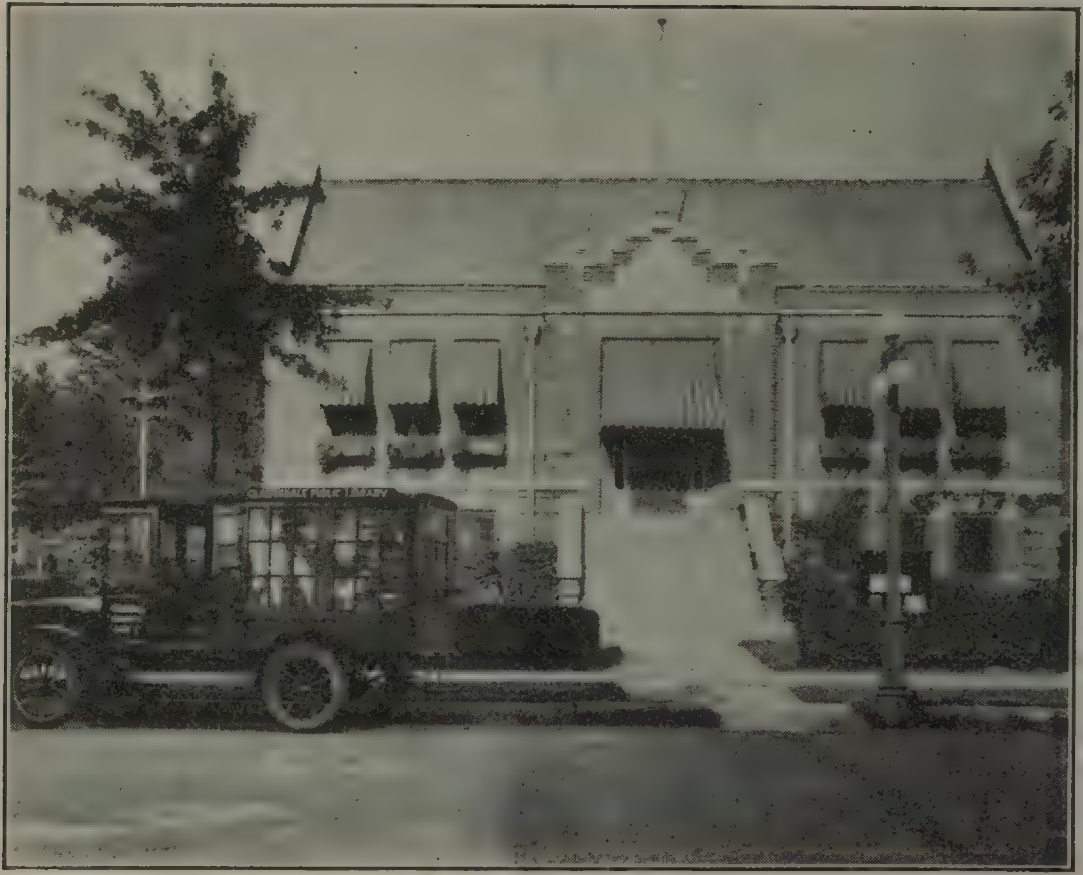

Fig. 11.—Coahoma County Library at Clarksdale. Miss. Book automobile ready for book-delivery trips to rural branches and stations

Financial report of the Coahoma County (Miss.) Library for the year 1926

Receipts:		
Amount on hand Jan. 1, 1926	$17.00	
City appropriation	7,500.00	
County appropriation	3,000.00	
Sale of books	189.12	
Fines, rentals, books lost	848.07	
		$11,554.19
Expenditures:		
Binding	503.39	
Supplies	243.02	
Salaries and substitutes	5,517.88	
Extra wages, yard work, etc	331.80	
Library dues, printing, and publicity	130.10	
Postage, express, freight	243.23	

Expenditures—Continued.		
Books, magazines, and newspapers	$3,819.72	
Refund on nonresident deposits	14.15	
County extension, upkeep of truck	124.92	
Repairs, improvements, library furniture	313.28	
		$11,241.49
Balance		312.70

The Clarksdale Public Library is governed by a board of five trustees who are appointed by the city commissioner. Two trustees live outside the city, and one is a farmer. The board appoints the librarian, who has three assistants, one in charge of county work. The present law permits the county to pay not only for books but for extension service.

The library has 600 selected Government documents, and efforts are made to keep them available to farmers, especially Farmers' Bulletins. They are listed in a card catalogue by subject headings. Pamphlets are filed in envelopes under a class number in a file case. Publicity is given to them by including them in book lists sent to newspapers or to library stations.

Story hours for children are conducted frequently by the librarians in school and library stations, and children's book week is celebrated yearly at the main library, at schools, and at stations. The county superintendent of schools sends to the schools lists of books which he would like to have the children read, and the country librarian brings books out by the book automobile for this work. The agricultural school for colored people has made especial use of the library.

The service that the library can give to country people is given wide publicity by issuing lists of new books and books on special subjects; by exhibiting attractive book covers in schools and stations; by decorating schoolrooms and stations with book posters; by furnishing newspapers with weekly articles concerning the library; by posting signs at library stations reading, "Public library, free service, books here"; by carrying signs on the book automobile which read, "County library department—Who wants? Let us know"; by giving library talks to farm organizations; by exhibiting books at fairs; by preparing reading courses and furnishing the books; and by cooperating with the county agent and the county superintendent of schools through providing new library material and going with them to rural meetings.

Jonestown School station.—The station library at the Jonestown School, 13 miles from Clarksdale, had, at the time visited, 200 supplementary books, changeable monthly, in charge of a teacher. There were 8 teachers and 146 pupils. The principal stated that the library was almost invaluable, as the books were used daily by most of the teachers and pupils. Teachers requisitioned books as needed. If pupils went to the town library they would not know what books to select. Pupils take home books by standard writers of the past and the present, and if the county library did not send such books the children would never read them.

Jonestown community station.—The community-station library at Jonestown of 400 books for adults, changeable monthly, is in the telephone office in a town of 646 population and is in charge of the operator who serves as librarian without pay. During school vacations she also has the children's books. The telephone office is used as a rest room. Cotton farming is the chief occupation of the people. The librarian stated that the library was of great value to the people, that there was a large book circulation, and that the semimonthly visits of the county department librarian in the book automobile were of great value on account of the exchange of books and the advice and help the librarian gave regarding books and other community affairs.

RUSK COUNTY LIBRARY, LADYSMITH, WIS.

About 30 years ago the redemption of the cut-over region of which Rusk County is a part, was in full force, which was a few years after the great forest had been denuded of its timber. Settlers came in, pulled the stumps, planted seed, built roads and towns, and now the 2,240 farm families of Rusk County are served with 102 book collections in schools, 24 traveling libraries, 3 community branches, and 1 collection in an established rural library, all the books coming from the county library by mail or by direct delivery. Though only 34 per cent of the county is as yet in farms, rural people borrowed 18,481 library books in 1926. As the central library had 7,056 books, this was an average of 2.6 books to each borrower and was one-third of the 55,176 total circulation of the city and county library. In 1926 the population of the county was 16,403, the farm population was 10,297, and the area is 925 square miles.

The book collections in schools consisted of 15 books each, changeable monthly, placed in charge of teachers. These books enable local teachers and pupils in the State reading circles to do the required work in pedagogy and general literature for which professional and school credit is received. In 1926, 6.953 teachers and 213.971 young people were members of the two circles in the State. Each teacher member was required to read at least 3 selected books and each young person 5 or 6 selected books, each year.

Traveling libraries consist of changeable packages of books on general subjects for adults and children and are maintained in various places throughout the county.

The community branches are of a permanent nature, but they have several hundred changeable books of a general kind including fiction, informational literature, reference books, and farmers' bulletins. They are located in stores, in villages of from 150 to 500 population, and books are loaned by the grocer or merchant. These branches were established in 1926 in an attempt to get books closer to the people on the farms, and the county agent aided in starting them so that he could send farmers and farm boys to them for agricultural books and farmers' bulletins. The branches are open as long as the stores are, and the storekeepers receive a small compensation for the work.

The county library furnishes study-club material to five rural women's clubs for the club programs, which are kept on file in the library. Supplementary material, farmers' bulletins, etc., are sent out by direct mail.

Financial statement of Ladysmith city and Rusk County (Wis.) library for the year ended December 31, 1926

Receipts:		Payments:	
Balance		Books	$669.98
City	$3,500.00	Periodicals	128.98
County	1,250.00	Binding	357.17
County appropriation of $2.000 made in November, 1926, from this used	440.05	Salaries, library service	2,830.75
Fines, lost books, reserves	249.79	Salaries, janitor service	81.60
		Heat	331.37
		Light	86.96
		Permanent improvements	69.60
		Repairs	139.27
		Stationery and supplies	240.52
		Printing	6.25
		Postage, express, freight	172.91
		Insurance	87.00
		Other expenses	238.12
Total	5,439.84	Total	5,440.48

The 1925 county appropriation of $1.250 was expended as follows: Books, $750; postage and freight, $100; county assistance, $250; librarian's transportation, $100; librarian's salary, $50; total, $1,250. The assessed valuation of the city of Ladysmith is $3,872,626, and that of the whole county is $19,033,925.

People are informed of the service which the library has to offer them by: (1) Frequent articles in county journals; (2) exhibits at county fairs including a sand table in which was pictured, through use of cardboard, the movement of books by automobile to branches, stations, and schools; (3) book displays at community fairs; (4) display map of county work at State fair; (5) welfare books placed on the county traveling clinic; (6) talks about books given by the librarian at all county teachers' institutes; and (7) cooperation established with the county superintendent of schools, county agent, and county nurse. A picture exhibit was sent to the Sesquicentennial Exposition at Philadelphia.

The Ladysmith town library was established for town people only, in 1906, in a storeroom in Ladysmith, the population of which is now 3,581. In 1907 it was removed to a new $10,000 Carnegie building, for which the town gave the site and agreed to furnish $1,000 annually for maintenance. The town gave $2,000 yearly and is now giving $3,500 yearly. Several years ago the county commissioners voted $500 to the Ladysmith Library for the purchase of books. In return, country people were permitted to borrow books from the town library. Later the county gave $800, and a few traveling libraries were sent out into the country. When the enlarged program for county service began in 1926, the county gave $1,250 for the year. In November, 1926, it voted $2.000 for 1927.

The county has a representative on the library board. The library is in charge of a trained librarian who has one full-time assistant and two part-time assistants. The library building has an auditorium which is used by the women's club, Girl Scouts, and Camp Fire Girls and for amateur plays, lectures, and other community events. The librarian makes automobile trips to the branches monthly and to the schools and traveling-library stations at least once a year. On these visits she delivers and returns books, gives advice and assistance to librarians, and holds story hours for rural children. The county allowed $124 for car expense in 1926.

The response of farm people to the library service may be gauged by the following statement made by the librarian:

> We are only beginning, of course. I am still a little amazed when I drive up on a Saturday night to a confectionery-store building in the town of Bruce, for instance, to see a red sign in the widow which says, "This is a County Library Station;" and go into the store to find an ice-cream parlor full of overalled farmers, red-cheeked children, and mothers from the country who are interested in books as well as in candies and ice-cream cones. Books come alive in such places. There is no desk to come between a human being and the book he wants to read—only a counter, and back of it a girl whom they can call by her first name as they scrawl their names on an application blank and draw out their first books.

This library was established as part of a movement to bring the same social and educational advantages to the farmer that are enjoyed by the city dweller. To extend library service to farm people it is not necessary that a county be old, highly populous, or wealthy. With intellectual advancement keeping step from the beginning with material advancement the desired goal—a good kind of rural life—is soon reached.

H. LESLIE PERRY MEMORIAL LIBRARY, HENDERSON, N. C.

People of means who wish to contribute to the betterment of their own community are turning to the public library in increasing numbers. For a long time New England has been especially favored with such libraries. The county-library building of Elizabeth City County at Hampton, Va., was a gift of this character. In a number of instances where the county system prevails, local branch-library buildings have been financed in this way, and such libraries and buildings are also built as memorials.

Until such a memorial was erected in 1924, to the memory of a deceased local citizen the only library that the city of Henderson, N. C. (population 5,222), possessed was a small school library. The building and most of the books and furnishing were provided by the donors. Numerous clubs and individuals gaves additional books and furniture.

The plans of the building were drawn by a library architect. The building has a large assembly room which is a general meeting place for various organizations of the town and is much used by farm people. The librarian uses it also for the children's story hour and for travel talks. The total cost of the donated property was $40,000, including $4,000 for books. It was dedicated for the use of the public as long as used for a library on condition that it be maintained. For this purpose the county board of commisioners vote $1,000, the county board of education $1,000, and the city council $3,000 yearly. (Fig. 12.)

A certain amont of money is being set aside annually to establish a library for negroes. Meanwhile a branch for negroes is maintained in one of the schools. Collections of books which are changed monthly are kept in all of the eight consolidated schools in the county. Further county extension work is contemplated, as it was the wish of the donors to give something especially worth while for county people. The library is open freely to all citizens of the county.

There are over 5,000 books in the library, and the circulation is 32,156. It is supervised by a board of 7 trustees, 2 appointed by the county commissioners, 2 by the county board of education, 2 by the town council, and 1 by the donors. The title to the library, is in this board. A trained librarian, who has two assistants, is in charge.

DEMONSTRATION COUNTY LIBRARY SERVICE, GREENVILLE, S. C.

A few interested citizens of Greenville, with the help of the city librarian, are responsible for library extension in Greenville County, S. C., which began in 1924. It was hoped that a successful three-year demonstration would persuade the county to assume financial responsibility for its continuance. The county demonstration service carried books from the Greenville Public Library to about 30,000 rural people in an area of 761 square miles, including four rural villages of from 1,000 to 2,000 population. Starting with an old subscription library in the city as a nucleus, similar demonstration service had already been completed in the city of Greenville and in the adjoining school district composed largely of mill villages, the employees of which were formerly farm people. The city service is now financed by a 2-mill city tax, producing $18,000. The school district appropriates $5,000 annually for its service. The county demonstration service was financed by $10,000 annual donations from the small interested group.

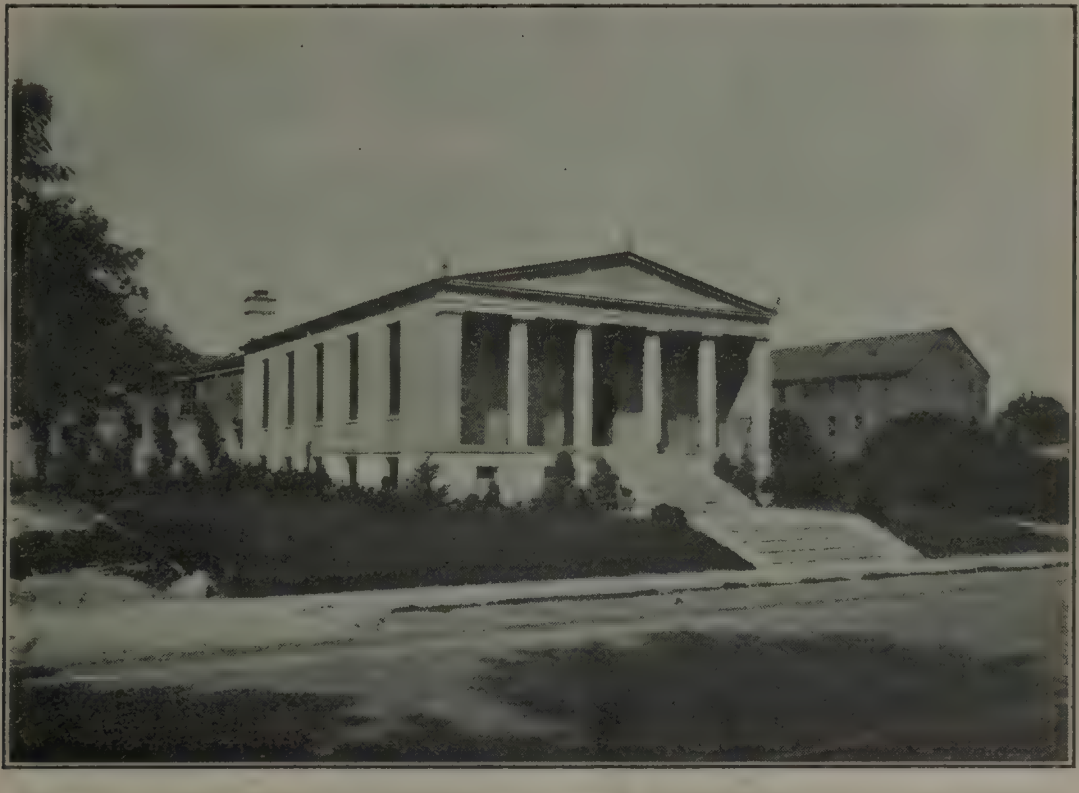

FIG. 12.—County library at Henderson, N. C. A memorial gift by a local resident

Of the $10,000, $5,000 went for books, $3,000 for the service of two extension librarians, and $2,000 for supplies and operating expenses, including upkeep of book automobile, garage, etc. The central library is in rented quarters, since the value of service rather than buildings was one of the purposes of the demonstrations. The building may come later.

Rural book service was given to 2 branch libraries, where books were left as long as needed; to 8 stations for adults; and to 38 school stations, where books were changed bimonthly. When schools were closed direct book-automobile service was given to farm homes. Thirteen "lay-by" schools for adults were also supplied with books. The total circulation of books in 1925 for the three services was 205,000, of which the town circulation was one-half, the school district one-fourth, and the rural one-fourth. The first five months of 1926, the second year of rural service, showed a loan of 41,000 books to country people, an 87 per cent increase over the similar five months of the first year. The central library also was open freely to country people.

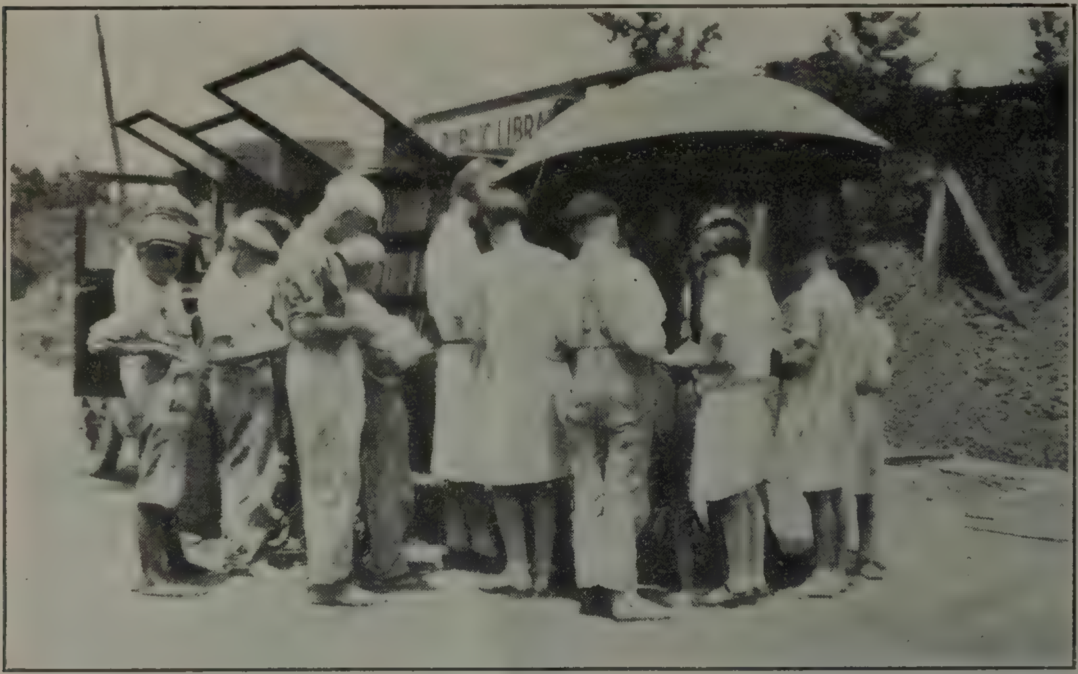

FIG. 13.—Country children selecting books from the Greenville County (S. C.) Library book automobile

Each service has its book automobile, which is an automobile reconstructed to carry 500 books. The county automobile is equipped with a large umbrella on a sliding roof rod at the rear, which when opened protects the users at farm homes or stations. (Fig. 13.)

On September 13, 1927, following a petition signed by one-fourth of the qualified voters outside of Greenville, an election was held to vote on the question of establishing county library service financed by the county. It was voted to levy a 1-mill county tax, which would bring in between $18,000 and $20,000 a year, and to contract with the Greenville Public Library for an extension of service to the county from that library. The money was to become available at once.

DIGEST OF SEVERAL COUNTY LIBRARY SERVICES STUDIED

The essential facts regarding several other county libraries which have been studied are given as examples of what has been done in this direction.

Camden County, Haddonfield, N. J.—Established by popular vote, 1922, serves 56,889 people exclusive of Camden and three other cities; 24,000 volumes in library, including 14,793 in stations, in 1924; 160 branches and stations, 76 with monthly book-automobile service, and 84 school collections of 85 books each. One-fifth of a mill library tax gave $10,124 in 1924; State gave $1,460.

Burlington County, Mount Holly, N. J.—Established by popular vote, 1921; serves all the county (population, 81,770); 38,982 books in library in 1926; 135 branches and stations, including 45 rural-school collections; 17,654 books taken by book automobile to stations, 1926; 23,982 books in branches in 1925. One-fifth of a mill tax on assessed valuation of $59,761,300 gave $11,952.20 for library purposes in 1925; State grant, $1,570.

Madera County Library, Madera, Calif.—Serves county population of 12,203 (census of 1920). Library building built, 1917; county funds, $12,500; 73,052 books in library in 1925; 20 community branches, 52 school branches. (Fig. 14.) Circulation in 1925, branch libraries, 41,902; supplementary school books, 20,155. Library automobile is used. Farm bureau, through farm advisor, uses books in study classes and uses moving-picture machine. Six-tenths mill tax on taxable assessed valuation of $22,874,162 brings $13,724.50; schools give $4,557; income from miscellaneous sources, $3,463.83.

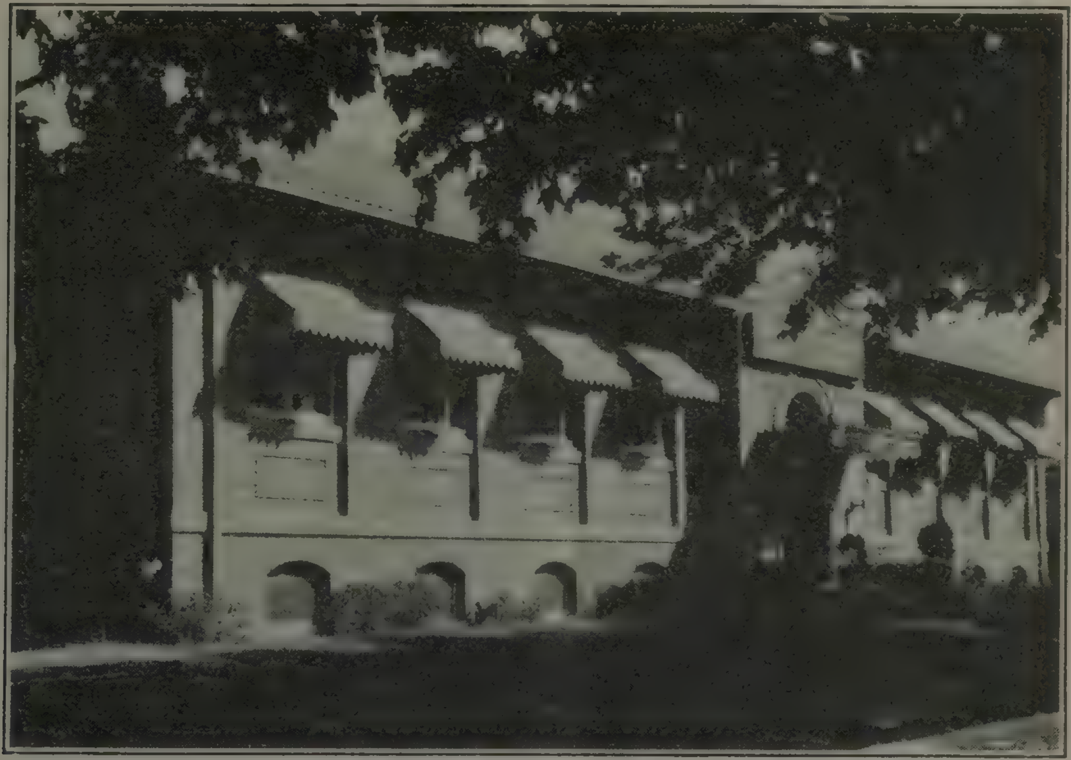

FIG. 14.—Madera County (Calif.) Free Library building. Erected by county at a cost of $12,500. Electric sign on front

Merced County Library, Merced, Calif.—Nineteen community branches (13 with reading rooms) and 62 school branches. Serves the county (population, 24,579). In 1926 the library owned 94,940 books, 7,275 pamphlets, 4,181 pictures, 1,004 music records, 464 music sheets, 5,289 stereographs, 544 periodicals, 2 moving-picture machines, and 4 slide lanterns; 176,118 items circulated. In 1926 registered borrowers numbered 17,449; 1,880 shipments of 45,154 items from main office to branches in 1926; 45,000 books and items used in rural schools. Librarian has the use of a county automobile. County owns building. County erected three branch buildings at cost of $5,500, $10,000, and $3,500. Eight-tenths mill tax on county taxable assessed valuation of $32,612,022 gives $25,501.47; schools give $7,574.50; miscellaneous receipts, $2,944.33, total $36,020.30.

Fresno County, Fresno, Calif.—Serves county population of 123,845, excluding a school district. Area, 5,940 square miles. Community branches in 1926, 104, 59 with reading rooms; school branches, 161. Bound volumes, 344,968; miscellaneous items, 55,143. Has a Government-document depository collection of 24,790 documents. In 1926 made 5,284 shipments of 117,142 items to branches. Owns two library-book automobiles. Visits to branches and schools numbered 1,547. Borrowers, 34,428. Eight-tenths mill tax on total $152,064,762 valuation produced $118,523.29; miscellaneous receipts, $36,371.55; total, $154,894.81.

Los Angeles County, Los Angeles, Calif.—Serves the county, exclusive of Los Angeles and 15 other towns. (Fig. 15.) Area, 3,583 square miles. Estimated 1926 population served, 408,936. In that year the library owned 530,586 bound volumes; other items, 6,225. Total number loaned, 1,461,403; loaned from branches, 1,430,670. Circulation, home use, per capita, 3.57. Total number shipments to branches and schools, 4,297; to branches only, 2,665 shipments of a total of 88,740 books; to schools, 98,460 books. Borrowers, 83,719; at branches, 79,864. Registered borrowers constitute 20.47 per cent of population. Community branches, 182 (with 70 reading rooms). Farthest branch, 116 miles. Schools served, 154. Total distributing points, 336. Total visits to branches by librarians, 2,830. Library owns two book automobiles. A four-tenths mill county tax gave $237,889.32. Total yearly receipts, $300,897.41.

Jefferson County, Birmingham, Ala.—In 1924 the county contracted with Birmingham Public Library. Serves county population, outside Birmingham and two other towns, of 107,571. In 1926 there were 63 county library stations (40 in schools) and 10,000 books in the county library. Circulation, 66,134. Owns one book automobile. County votes $10,000 yearly.

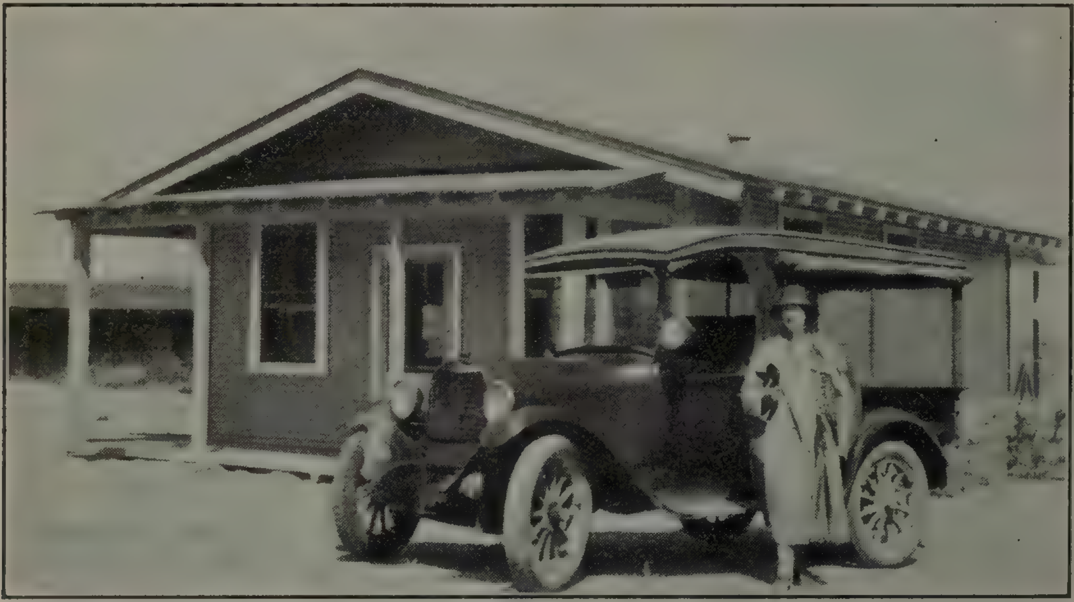

FIG. 15.—Librarian of Los Angeles County Library (Calif.), delivering books by book automobile to Honby branch library, 50 miles from headquarters

Harris County, Houston, Tex.—Established 1921. Serves population of 48,391 outside of Houston. In 1926 owned 22,785 volumes; has 71 rural stations; 132,825 books were circulated from all branches that year. Service cost estimated 11 cents per book. Library has use of a county automobile. Cost of library operation, $17,211.47. County gives $17,000. Staff is composed of the county librarian, three assistant librarians, and three clerks.

LaCrosse County, LaCrosse, Wis.—Establishment (1924) proposed by farmer member of county board of supervisors. Serves population of 13,934 outside of LaCrosse. In 1926 owned 3,114 books. Had 40 traveling libraries, circulation, 3,514; required school reading circulation, 2,746; total county circulation, 8,162. County appropriated $1,600 in 1926, which was double the appropriation for 1925. Assessed valuation outside of LaCrosse, $17,213,429.

Hamilton County, Chattanooga, Tenn.—Established in 1909. Operated under contract with Chattanooga Public Library. Serves 58,059 country people. In 1925 owned 81,035 books and 6,245 pamphlets. Had 9 permanent branches with 1,500 books each, 63 stations which had 50 books for 2 months. County circulation in 1910 was 2,850; in 1925 was 85,069. Publications of the United States Department of Agriculture are much circulated. There were 220 borrowers of agricultural bulletins in 1926. One exclusive county-work librarian. County gave $1,500 in 1910, $8,400 in 1926, $15,000 in 1927.

Warren County, Monmouth, Ill.—Established by popular vote, taking over endowed county fee library. Serves whole county, 21,488 people. In 1926 had 4 branches, 8 stations, and 33.000 books. There were 7.620 card holders (3.127 in branches). County circulation, 148,046; branches' circulation, 53,640. Eight-tenths mill tax gave $18,000.

Hennepin County, Minneapolis, Minn.—Operates under contract with Minneapolis Library. Serves rural population of 34.837. In 1925 had 19 branches, 13 stations, collections in 75 schools, and operated direct monthly book-automobile service to 168 farmers. County-library collection was 24.533 volumes. Volumes distributed, 22.474. Branch circulation, 161,783; stations, 9.809; schools, 13,402; book automobile to homes, 10,171; total circulation, 195,165. Valuation county library equipment, $26.273.54. Library expenditures during 1925, $24,322.64. One-mill county tax gives $25,808.

Phillips County, Malta, Mont.—Established in 1917. Serves 9,311 people in area of 5,178 square miles. In 1926 owned 6.410 books. Had 20 rural branches and 45 school stations. Farthest branch. 89 miles away. In 1926, 20,309 books were sent out from Malta. One-fourth mill tax gives $3.041.17.

Allen County, Fort Wayne, Ind.—Operates under contract with Fort Wayne Library. Serves 27.754 rural people. In 1926 had 4 branches with buildings erected by county; 17 stations in stores, farm houses, etc., with librarians' salaries of $5 to $20 monthly paid by county. Owns one book automobile. Had 176 schoolroom collections in 98 schools. County gives $23,389.

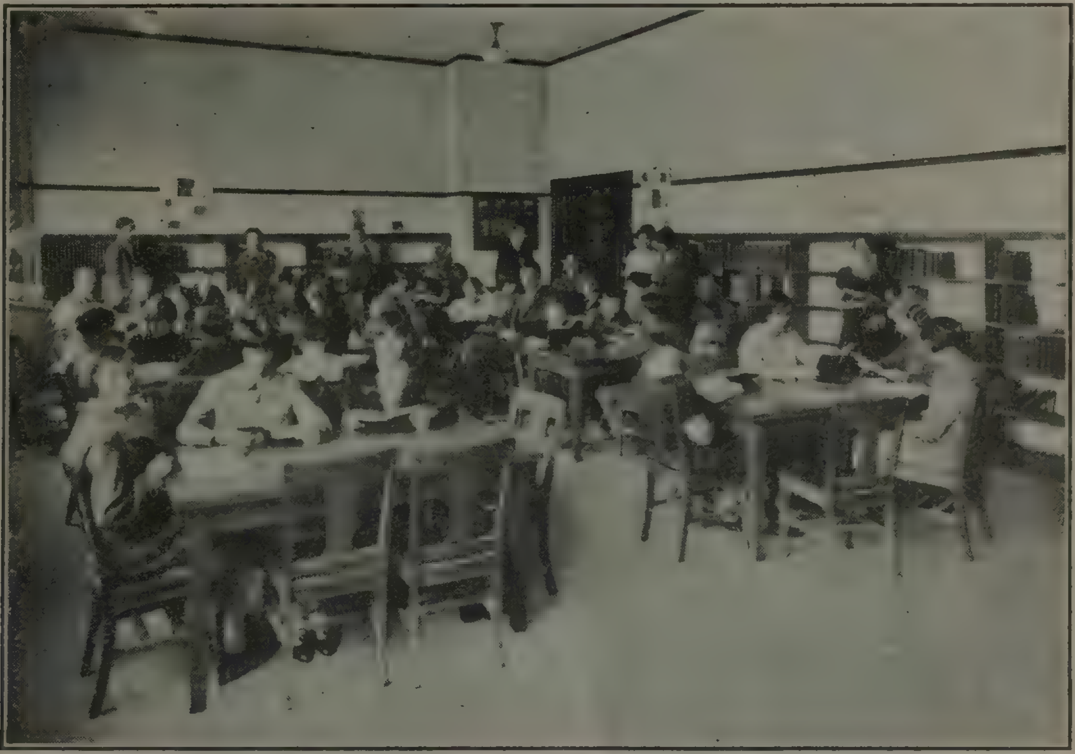

FIG. 16.—Branch library at Lookout Junior High School, St. Elmo, Hamilton County, Tenn.

Washington County, Greenville, Miss.—Operates under contract with Greenville Library. In 1926 had five public library stations in consolidated schools. Owned 17,500 books. Furnishes reference books for schools. County gives $1.200 for rural population of 22,498. A start toward real county library service.

Jefferson County, Louisville, Ky.—Operates under contract with Louisville Library. Serves rural population of 51,478. In 1926 had 17.665 books, 25 rural stations (20 white, 5 colored), 145 classroom collections (113 white, 32 colored) in 67 rural schools. Stations maintained by county. Owns one book automobile. County station circulation 60,212. County gives $12.500.

ADVANTAGES OF THE COUNTY LIBRARY SYSTEM

This study of the more than 100 rural libraries seemed to show that among them the advantage was decidedly with the county system. This system seems to offer equality of opportunity, service, and economy.

EQUALITY OF OPPORTUNITY

Farmers ask nothing more along economic, educational, social, or other lines than equal opportunity with other groups. In library matters the county system gives them this because under this plan the people pay for what they receive and receive what they pay for. They receive according to what they pay, as do other groups. In the case of a library system supported by a county tax, equal-pay opportunity comes through taxation fixed by the people or by county-elected officials. Equal service is approximated through use of local branches and stations with transported and changing book supplies; advice and service of visiting trained librarian; and availability of central library. Equal control and management come through county-elected officials or their appointees.

In the case of contract libraries, county-elected representatives determine the county part of the library budget and have county representatives on the management boards, whereas the library gives service through branches and stations proportionate to the amount the county pays as determined by a management in which the county shares. A town with an existing library may come in or may stay outside of the system.

SERVICE

The taxable wealth of a large unit, the county, is behind the service of a county library. A large and well-selected book stock is available, in the selection of which rural interests are considered. Changing supplies of books, both general and agricultural, are transported directly to the farmer's home or neighborhood.

An expert librarian, who has had from one to three years of library-school training, directs the system, gives assistance in book selection, and offers expert advice to branch librarians and to library users on the days of her visits. This librarian cooperates with the county agent, county superintendent, and all rural organizations in the interest of the farmer's library welfare; she influences the lives of farm boys and girls; for men and women her educational and social influence is incalculable in country districts. Direct mail service from the main library is available to the most isolated farmer, and special books may be requested by telephone. Direct service at the central office is equally available. Service is given to any small-town library that may wish to preserve its identity. Schools are served with reference books, supplementary material, and books for children.

A larger proportion of the library funds are expended for service than for large buildings or for salaries of untrained librarians. Library service is made intimately known to country people who know little of city or State services and hesitate to use them when they are available. (Fig. 17.)

ECONOMY

The extensive unit area, the large population, and the available wealth of the average rural county make it possible to establish a library that will give better service and more nearly equal opportunities to farm people at less expense than does any other rural or small-city unit. A recent study of rural social institutions in Wisconsin, in which the United States Department of Agriculture cooperated, concludes that 4,000 population is the minimum for good library service at standard cost.[6] Savings are made through (1) quantity purchases, (2) reduction of overhead cost of tools and operation, (3) lessening the accumulation of unused books, for if one group does not care for them another group may, (4) expert selection of books, including expensive reference books, (5) county service of a trained librarian, (6) free exchange of books, and (7) lowered building costs.

FIG. 17.—A county library display. Part of an armistice day anniversary parade

The experience of California and other States seems to prove that schools that are served with reference and supplementary books through the county library receive much better service at less expense than through any other method. Comparisons of rural county library service with service of libraries in small cities of similar populations indicate that better service is given in counties at considerable less expense than is given in such cities. Many small cities that have tried to maintain their library individuality after the county system was started have later joined the county system as a matter of economy. If any small city has left the county system the fact is not generally known.

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[6] KOLB, J. H. SERVICE INSTITUTIONS FOR TOWN AND COUNTRY. Wis. Agr. Expt. Sta. Research Bul. 66, 61 pp., illus. 1925.

As between the full county system and the system under which a county contracts with a city library, country people appear to receive better service at less expense under the full county system, especially after initial establishment. In some localities good county library service is being given both to city and to country people at less than the cost of one good book per capita. A high grade of service to city and country people and to schools is being given in many rural counties at a maximum tax of 0.5 mill. The National Grange, by resolution, indorsed the county-library plan in 1923 and the Women's Auxiliary of the American Farm Bureau Federation indorsed the plan in 1927. The General Federation of Women's Clubs and National Congress of Parents and Teachers actively support the plan.

HOW LIBRARIES ARE STARTED

Establishing a library before the time for one is ripe or establishing the wrong type of library often results in a struggling library and a bad impression which retards library development for many years. Expert advice is first sought if no mistakes are to be made. It has been found to be best, before starting a library, to communicate with the State library commission or State library, or if the State has neither, to write to the American Library Association, 86 East Randolph Street, Chicago, Ill. Sometimes an individual-trained librarian can give good advice. The State library law should be studied. Whether a State library is to be instituted and what kind to be established should be determined by a careful survey of the whole situation.

THE SURVEY

This survey is usually made by a committee that represents those interested in establishing the library, preferably aided by a representative of the State library commission. Since a political unit which has large financial and population support and yet is small enough to be effectively administered has been found to be best for this purpose, the county system is generally the objective in those States that authorize it. In some instances the compact township or the school-district unit may seem to promise the best service. Sometimes a small town located in a county of limited financial resources and small population appears to find the library problem best solved by a town library that offers its facilities for the use of country people. Even a membership-fee library, where no better kind can be obtained, has been found to meet some rural situations.

In any event, a careful survey by a group of trained persons who have in mind the greatest good for the greatest number, now and in the future, and a study of the experiences of similar libraries and of existing library laws, will determine the best type. After the type has been chosen much still remains to be decided. In the case of the county and other large-unit libraries there are the questions of actual library needs; existing library facilities, and whether existing libraries will enter the new system or remain outside; the taxable wealth of the unit; the amount of money needed for the best service and the amount obtainable, which involves the present county taxes, their distribution and use, and possible savings to be made; the tax rate needed to produce this money, based on population and property valuation; possible location of library headquarters and branches, stations, and school collections; distribution of population, and of highways, electric lines, rural-mail routes, railroads, and other means of transportation; the number of probable library users in each community; and the question whether this is the propitious time to start a campaign for the type of library decided upon. Surveys for smaller-unit libraries will include many of the same items.

THE CAMPAIGN

After the type of library has been determined upon, a campaign is helpful in getting this type accepted. The purpose of the campaign is to convince the public of the value of library service and of the type determined upon, so that the citizens will be willing to pay for the service, knowing that they will get value received, and to show that library service is a public utility rather than a luxury or a charity. The campaign involves many or all of the following: (1) Formation of a directing organization of many widely chosen representatives of various organizations and of the press, with an executive committee for direct action, (2) continuous, intelligent, systematic use of all available press service, (3) convincing public officials, especially those directly involved, of the need and demand for library service, (4) continual discussion through press, pulpit, school, women's clubs, and other community organizations and moving-picture houses, (5) securing the interest of leaders of political organizations, both men and women, (6) circulation of petitions to be signed and presented to public officials whose duty it is finally to determine the question, or whose authorization may be needed to present the question to popular vote, (7) making known the actual cost and service benefits, (8) use of popular devices like placards, posters, slogans, tags, buttons, and endless-chain telephone messages, and (9) a final public termination of the campaign on the day the question is to be decided.

THE BOOK AUTOMOBILE

The book automobile is an important adjunct of library service to rural communities, especially in connection with county libraries. It is a means of transporting books from the central library to branches, stations, schools, and individual farm families, and a means of their return. It also transports the central librarian in her visits to these places. Many county libraries are giving very good country book service through the mails and by other methods of transportation, but the book automobile makes possible a more equal, complete, and regular service to country people. It has been defined as "a library station on wheels." Its forerunner was the horse-drawn "book wagon," first used by the library of Washington County, Md., in 1905, to transport books direct to country people. This county is now using a book automobile. In 1923 it gave periodical service direct to 3,500 country men, women, and children.

The book automobile usually consists of an automobile chassis upon which has been placed a specially built covered body about 8 feet long. Back of the driver's seat, bookshelves are placed on either side which hold 500 or more books. The body has doors or windows in the rear and the sides, sometimes of glass. These doors or windows are built to slide or rise to display the books. Some of the book automobiles have an interior folding charging desk placed back of a revolving seat beside the driver. Others have a two-section back door; one section can be lifted as a weather protection and the other can be lowered to form a charging desk. Some large counties have 2-ton book automobiles that carry supplies and furniture for branches as well as the books. The township library of Middletown, N. J., has a book automobile which carries 500 books to 13 stations and to private homes. Monroe County, N. Y., inaugurated a county traveling library system in 1923, using a 2-ton bus chassis with a specially built body which shelved 1,600 volumes and accommodated from 15 to 20 persons.

Many counties use an ordinary automobile and carry books in the body. It may be the county-library machine or the librarian's private car for which the county allows expenses for library use. Library signs are conspicuously placed on the book automobiles.

The original expense of the usual reconstructed car varies from $400 to $600 for the car and from $300 to $500 for the special body. Maintenance expenses vary. Camden County, N. J., had a garage expense of $364.24 out of a total library expenditure of $8.336 for 1923, covering the delivery of books by the librarian to 133 rural stations about three times each week to each station.

Hennepin County, Minn., had $476.08 book-automobile expense in 1925, out of a total expenditure of $24,322.64. Regular visits were made by the librarian or assistant to 107 county distributing points and 168 individual rural homes in distributing 22,474 books. The city and county library at Greenville, S. C., operates two book automobiles and a trailer. For the county car in 1925, garage rent was $60 yearly; gas, oil, and repairs $153.21; insurance and license $58.16. Cass County, Ind., with a yearly car service of 5,488 miles, reports $265.10 for automobile maintenance—less than 5 cents a mile. The book-automobile of Harris County, Tex., costs $50 monthly for upkeep. The library book automobile of Coahoma County, Miss., transported the librarian and 13,050 books to 21 stations in 1925, at a car expense of $230 for oil, gas, repairs, etc. The librarian usually drives the car.

Perhaps the most valuable factor of book-automobile service is the trained librarian who accompanies the automobile to branches, stations, schools, and rural communities. Opinions differ as to the relative value of book-automobile factors. A leading official of Jefferson County, Ala., in evaluating these factors and their influence on rural communities in that county, ranks the books two-tenths, the book-automobile one-tenth, and the county librarian seven-tenths. It is well to remember that if it were not for the book-automobile the books might arrive less frequently and regularly, and the county librarian might come but rarely. (Fig. 18.)

LIBRARY BUILDINGS

Service, or getting the books to the people, is the objective of good libraries. A trained librarian gives surprisingly good service even without a fine library building. Many expensive buildings have poor service. Much money has been wasted in providing monumental buildings, a part of which could have been used much better in providing for the services of a trained, or at least experienced, librarian or for the extension of library service to farm people. Librarianship, like teaching, is a profession which requires special training for best results, under modern conceptions of library functions, although there are many examples of good service performed by untrained librarians in times past under primitive conditions and former conceptions of library functions.

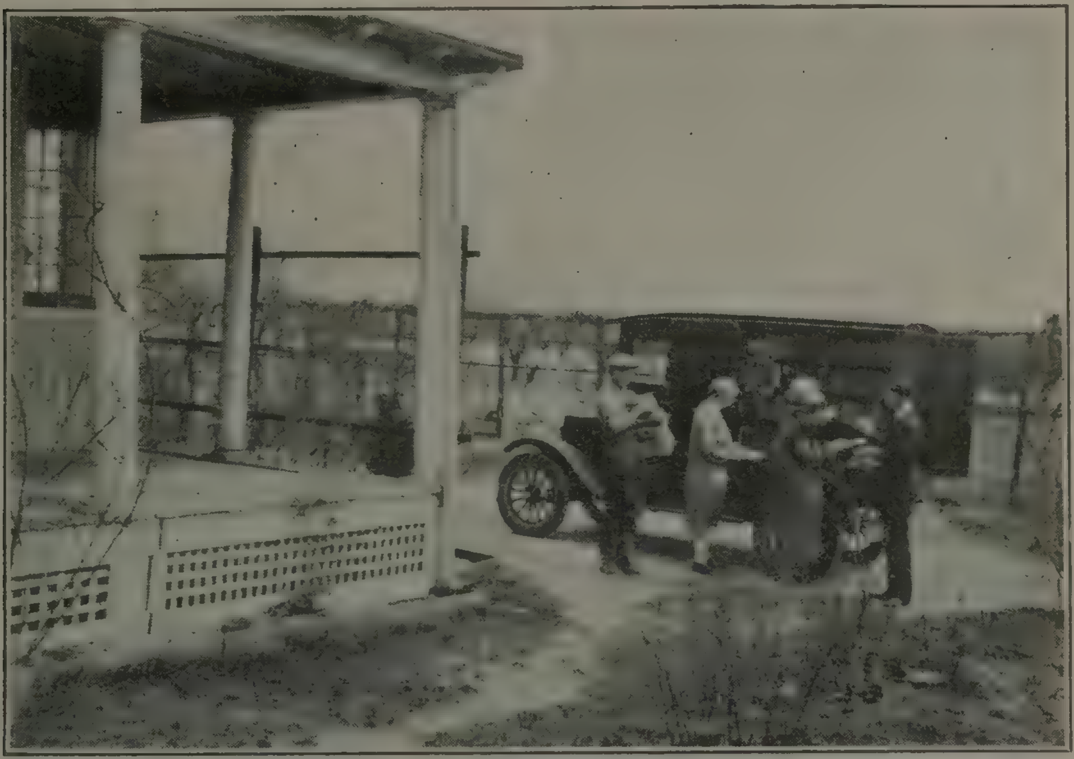

FIG. 18.—Librarian of Camden County (N. J.) Library, delivering books by book automobile at a rural branch library

In county libraries, particularly, a trained librarian is of great importance in selecting books, cooperating with public officials, preparing budgets, directing expenditures, and furnishing effective service to distant branches and stations. Here an expensive, elaborate building is unnecessary as most of the books are in branches, stations, and schools. A substantial, well-planned building is a medium of effective service, even for a country library, but the building should not be at the expense of service. Complete service in rented quarters is better than incomplete service in a fine building. Building plans drawn for city library buildings are not always suitable for county buildings, as special packing and distributing spaces, country women's rest rooms, and children's rooms may be more important in a county than in a city library.

In all types of libraries the building is an important adjunct. It stimulates local pride, gives satisfaction to those who have worked for and are responsible for establishing the library, gives dignity and stability to the service, and, when rightly planned, facilitates good library operation.

Experience has evolved certain good practices regarding buildings: They are usually planned by library architects who are familiar with modern-library functions. If another building is to be duplicated it is one which particularly fits the local type needed. The librarian who takes charge of the building is consulted in the planning. Dignity, attractiveness, endurance qualities, and serviceability are more important than ornate or showy features. Allowance is made for growth and extension of service. A donated building is not accepted unless there is assurance of sufficient future income for good library service. Whether a building has a public assembly room, museum, or art gallery depends largely upon local conditions, including the probable need and utilization, and whether there will be sufficient funds to maintain them after real library service is provided for. The library is so located as to facilitate its use by the greatest number of people. The modern trend is to build near the business center where many pass, and to build on or near the street line, perhaps on its level, for ease of entrance and possibility of window book display. The building is surrounded by well-kept grounds. The State library commission is consulted on building problems.

LIBRARY PUBLICITY

Of what use is a library book on hog cholera, or a bulletin on the hot-pack method of canning, or a good book of fiction to a farm family if the family does not know that the book is in the library or even in existence? "No scrub books" has become the modern library slogan. Books must pay their way or go. The progressive farmer disposes of animals that do not pay for themselves in use; a progressive librarian takes similar action as to books. The modern merchant hunts his market and does not wait for the market to find him. So with the modern librarian. Quick turnovers is an up-to-date business preference which has been adopted by up-to-date librarians. To have quick turnovers, the availability of the book when needed, must be known.

Some librarians set aside a definite sum from the budget for publicity purposes. Successful publicity convinces people that the library has what they want. The modern librarian uses various methods to give publicity to her wares.

Interesting news and items about the library are furnished to all county papers and for the county agent's news letters, together with lists of new books and lists of special books available for special problems of particular occupations or groups.

Library exhibits are attractively arranged at local, county, and State fairs, and groups of special books are displayed at meetings of particular groups. (Fig. 19.)

Decorated floats are placed in parades and pageants and are used on other gala occasions.

Illustrated bulletins and posters are placed on library walls, in windows, on outside bulletin boards, and in other outside places.

In travels over the county, many occasions are found by the librarian to tell rural groups about the library.

Many new libraries are being located in the busiest part of town, close to or on the street, with doors at street level to facilitate entrance. If the library is placed at a distance from the street, easy entrance is provided; architecture is made inviting; and the grounds are attractively laid out.

Window displays are used at all times, but locating the library on the street level near the building line gives great opportunity for attractive book displays, especially of new books and books on selected subjects.

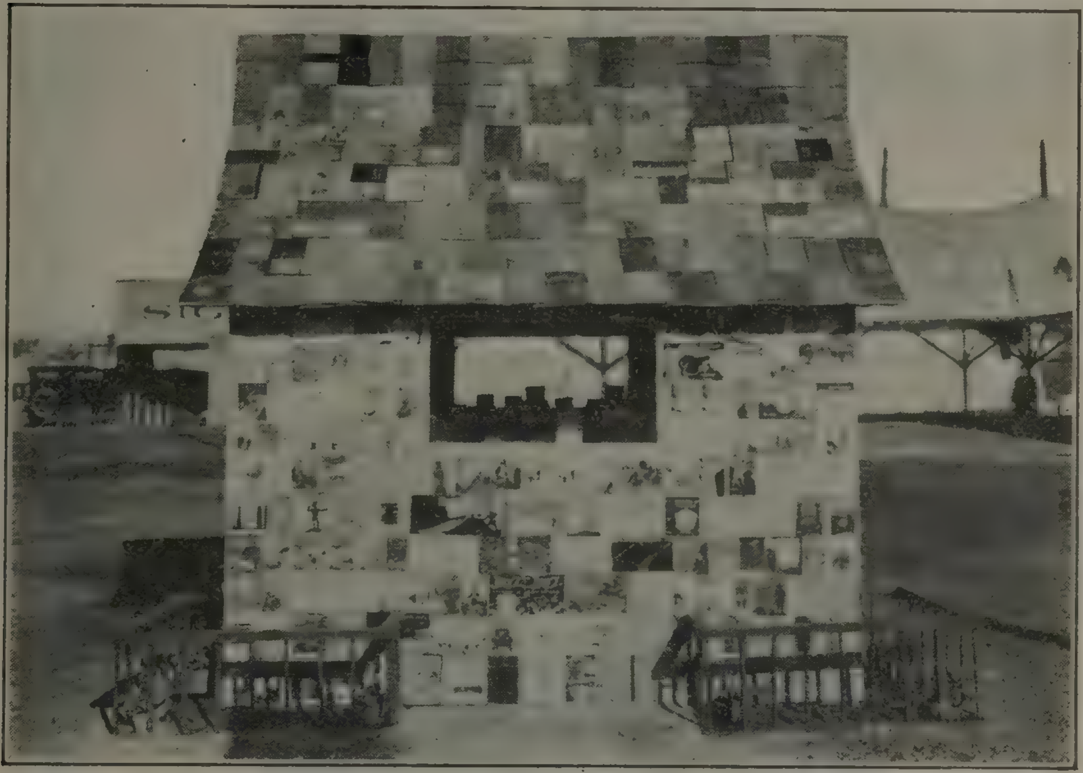

FIG. 19.—A book-jacket library exhibit made by a county free library on the county fair grounds

Good rural librarians join rural organizations in order to learn how they can serve rural people most effectively. New Jersey county librarians have joined the grange.

County libraries that own book automobiles make effective use of them in travels about the county, giving publicity to the library, interpreting the book needs of farm people, and making known the possibilities of the library in solving the special problems of the farms. North Carolina, Iowa, Pennsylvania, and Oregon use the book automobile over the State to advertise both State and county service.

Large, attractive library signs at headquarters, smaller uniform signs at all branches and stations, and adequate signs on the book automobile remind all citizens of free book service. The large "County Free Library" electric sign of the library of Madera County, Calif. (fig. 14), makes a striking appeal.

Rural librarians cooperate in every possible way with county superintendents of schools, teachers, county agents, health officers, and farm bureau, grange and farmers' union officials, in order to make known the efficacy of library service.

Short, concise, and interesting bulletins informing rural people just what their library has and can do for them are used to advantage, as are clear, informative annual reports showing the best possible library service at the lowest cost with the money available.

Homelike, inviting library quarters and a friendly spirit of service on the part of all employees are distinct assets.

Local theaters are often willing to run interesting library slides or short films.

Annual celebrations are useful, such as library day, when the library keeps open house and invites all the citizens to view its workings; and children's book week, a special week for children.

The service that a library gives is the most effective form of publicity.

CONCLUSION

Farm and village communities have established various successful types of library service. A number of States have, by statute, made possible the establishment of the best types of libraries for farm and village people. The officials of many counties, townships, and villages have instituted, by local financing, various successful rural libraries. Various library agencies and librarians have been active in assisting rural people to secure a number of successful types of library service. The purposes of this bulletin will be accomplished if rural people, State legislators, local officials, and library agencies, in view of demonstrated accomplishments, cooperate to make rural library service, as compared with other forms of public service, equal, efficient, and complete.

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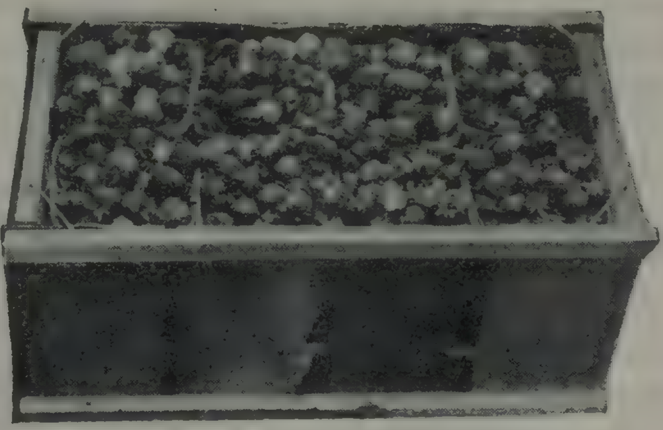
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1560

Revised Oct '40

PREPARING STRAWBERRIES FOR MARKET



STANDARD STRAWBERRY GRADES are desirable as a guide and basis for the use of growers in preparing their crop for the market, of buyers in the purchase of fruit, and of inspectors at the point of shipment or destination.

Growers should aim to produce berries of such uniformly high quality that no hand grading is necessary, as any extra handling adds to the liability to decay. In many instances, however, hand grading is necessary and profitable. The logical place to grade berries is in the field. Whether or not the strawberries have been hand or field graded, the filled boxes should be classified as to grade before they are placed in crates for shipment.

This bulletin describes efficient methods of preparing strawberries for market. The unsatisfactory condition and grade of berries often found on the markets indicates a need for more attention to standardization and better handling methods.

This bulletin is a revision of and supersedes Farmers' Bulletin 979, entitled "Preparation of Strawberries for Market."

Washington, D. C. Issued March, 1928

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PREPARING STRAWBERRIES FOR MARKET

By R. G. Hill, *Marketing Specialist, Division of Fruits and Vegetables, Bureau of Agricultural Economics*

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IMPORTANCE OF GOOD HANDLING

SUCCESS in marketing strawberries is dependent to a large extent upon the proper picking, grading, and packing of the fruit. Strawberries of a dependable grade and pack inspire in the trade a confidence which is reflected in a greater demand and higher prices for the product. The best of marketing facilities, however, can not overcome the handicap of indifferent handling methods, and good prices ordinarily are not obtained for an inferior product. Dissatisfaction and lack of stability in the markets are caused, in a large degree, by carelessness in the preparing of fruit for market. Improvements in handling methods should come about through the systematic efforts of growers with the earnest cooperation of dealers, and through cooperative marketing organizations.

THE LABOR PROBLEM

Unless they are engaged well in advance of the harvest season, the grower often is unable to secure a sufficient number of pickers to harvest the berries as fast as they ripen. If graded out, the overripe berries are a total loss; if packed, they reduce greatly the value of the firm berries with which they are marketed.

Men, women, and children from the neighborhood are preferable to transient labor. Usually they can be depended upon to remain throughout the harvest season. If there is a large acreage of berries in the neighborhood, however, outside help frequently must be obtained. Some families have camping outfits and travel from one strawberry district to another as the season advances. Many growers contract for labor from outside the immediate neighborhood and furnish free camping facilities. (Fig. 1.) Many strawberries are picked by persons who begin work when the harvest begins, in the Southern States, and follow the berry season north. These laborers usually are efficient but are not always dependable. Many pickers stop work after the height of the season or as soon as the best of the picking is over. In some strawberry districts a premium, in addition to the regular picking price per box, is offered to the pickers who stay until the end of the harvesting season. This plan is illustrated on one of the tickets shown in Figure 2.

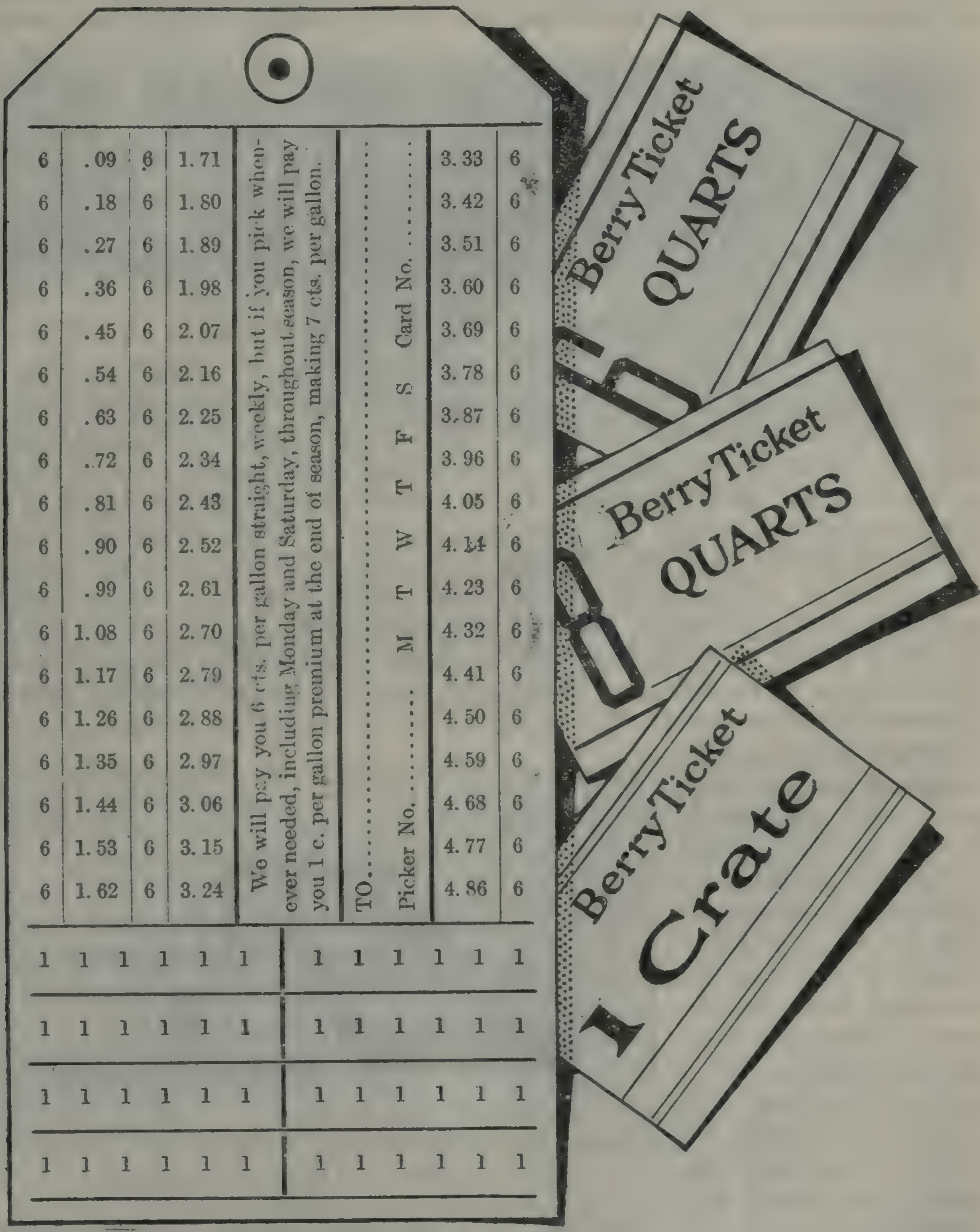
PICKING

Proper supervision of the picking force is especially important with the strawberry crop on account of the class of labor ordinarily used and the ease with which the berries are damaged. The quality of the berries delivered to the packing shed depends, to a large extent, upon the efficiency of the person in charge of the pickers. Usually a "row boss" or foreman is placed in charge of a group of pickers. He sees that rows are assigned to the pickers, that no ripe berries are left unpicked, that the number of green or otherwise defective berries placed in the box is held to the minimum, and that the pickers do not trample on the rows unnecessarily while picking or when walking to and from the packing shed. The number of pickers a foreman can supervise to advantage ranges from 25 to 40. The grower can advantageously spend most of his time in the general supervision of the picking, grading, and packing operations.

FIG. 1.—Camp for strawberry pickers, constructed by the grower

When berries are ripening rapidly the fields should be picked each day, and, if possible, the picking and packing should be done during the cooler parts of the day. The proper stage of ripeness for picking strawberries depends upon the variety and the distance to be shipped. Some varieties are naturally firm and can safely be allowed to attain a full red color; others soften quickly upon ripening and must be picked before they are full red color. Varieties which soften quickly are not suitable for long-distance shipment. Obviously, berries for local markets should be allowed to ripen more fully than those intended for distant markets.

Most of the shipping associations in Southern States, from which berries must be transported long distances, have picking instructions that call for berries from about three-fourths colored to a full red color. It is not possible to have all berries picked at exactly one stage of ripeness. When the pickers are instructed to pick with three-fourths full red color, berries may be found in their trays which vary from one-half colored to full red color, depending largely upon the experience and efficiency of the pickers and the closeness of the field supervision. Proper supervision of the pickers reduces this variation to a minimum. Strawberries must be picked when firm enough to be transported to market and distributed to consumers successfully, but all fruits sell, to a large extent, on their appearance, and, other conditions being equal, well-colored berries sell faster and return larger profits than does poorly colored fruit. Growers and shippers will find it profitable to trace enough of their shipments to market to determine whether they are being delivered to dealers in the best possible condition. In this way losses may be avoided and the grower may get suggestions which enable him to make a better appeal to the consumer's appetite, which result in an increase in the consumption of strawberries.



6	.09	6	1.71		3.33	6
6	.18	6	1.80		3.42	6
6	.27	6	1.89		3.51	6
6	.36	6	1.98		3.60	6
6	.45	6	2.07		3.69	6
6	.54	6	2.16		3.78	6
6	.63	6	2.25		3.87	6
6	.72	6	2.34		3.96	6
6	.81	6	2.43		4.05	6
6	.90	6	2.52		4.14	6
6	.99	6	2.61		4.23	6
6	1.08	6	2.70		4.32	6
6	1.17	6	2.79		4.41	6
6	1.26	6	2.88		4.50	6
6	1.35	6	2.97		4.59	6
6	1.44	6	3.06		4.68	6
6	1.53	6	3.15		4.77	6
6	1.62	6	3.24		4.86	6

We will pay you 6 cts. per gallon straight, weekly, but if you pick whenever needed, including Monday and Saturday, throughout season, we will pay you 1 c. per gallon premium at the end of season, making 7 cts. per gallon.

TO..............................

Picker No. .... M T W T F S Card No. ....

1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1

Berry Ticket QUARTS

Berry Ticket QUARTS

Berry Ticket 1 Crate

FIG. 2.—Two common forms used as pickers' tickets

Pickers should be taught the proper method of picking. Large quantities of desirable berries may be ruined by carelessness, indifference, or inexperience in picking. The best picking is done by the use of the thumb and forefinger (fig. 3), each berry being pinched off, with a stem about three-eighths to one-half inch long, and placed carefully (not thrown, tossed, or dropped) into the box. To gain speed, there is always a tendency to pull or snatch the berries from the plant and toss them into the boxes. Some pickers crush, bruise, or squeeze much fruit by holding too many berries in the hand at one time; others pile up berries on full trays which must later be taken off and placed in other boxes. Such practices result in bruising the berries and often mean the loss of many of the hulls or caps. Damaged berries and berries without hulls do not carry well to the market, and should not be placed in the boxes. Unless each row is picked clean of all berries that are ready, the next picking will contain overripe fruit.

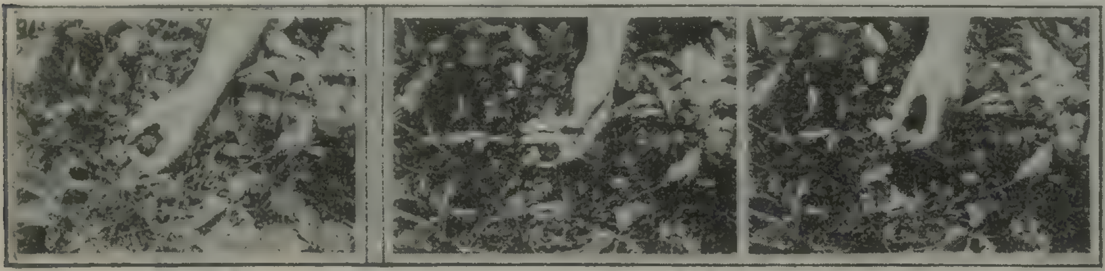


FIG. 3.—Proper method (left) and two improper methods (right) of picking the strawberries

Two methods of giving pickers credit for their work are in common use, either of which seems satisfactory. (Fig. 2.) Under one method small tickets are issued, bearing numbers conforming to the number of filled boxes delivered to the packing shed. The "meal ticket" method also is common. Tickets or tags are issued bearing printed figures either in terms of money or in numbers of boxes, or both. These tickets are punched as the berries are delivered. Some growers who employ this method find it necessary to use an adjustable punch which can be changed from day to day to prevent misrepresentation. With either method the picker may cash his tickets at stated periods. In many sections the tickets are accepted by local storekeepers as cash in payment for purchases. By a third method, which seems practicable where many pickers are employed, a bookkeeper is stationed at the entrance of the packing shed, who records, in plain view of the picker, the number of filled boxes which he delivers.

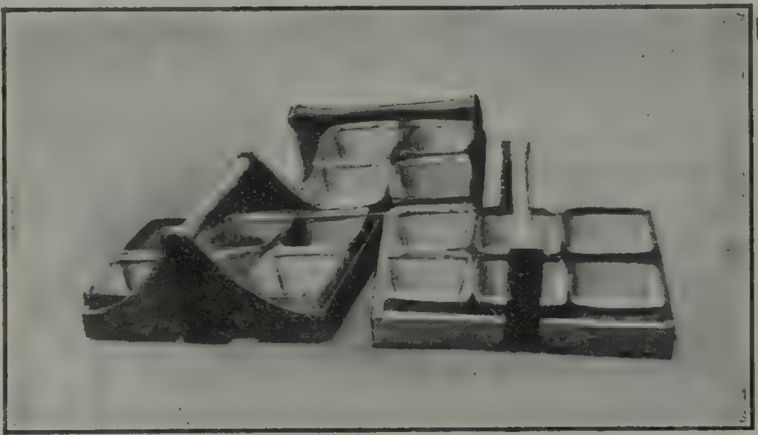


FIG. 4.—Convenient and popular-sized picking tray

The trays used for carrying the berry boxes into the field, whether made at home or in a factory, should be light in weight, substantial, and so built that the boxes fit in them snugly. They are made in different sizes holding from 4 to 12 boxes. The most popular sizes are those which hold 4 or 6 boxes. (Fig. 4.) The large trays are unwieldy in the hands of the picker, and unless provided with legs, can not be placed on the ground in the field without danger of crushing unpicked berries. (Fig. 5.) So much time is used in filling the large trays that there is danger of the fruit becoming overheated by exposure to the sun before it is delivered to the packing shed. One tray at a time is enough for each picker to carry to the field, to be delivered to the packing shed as soon as it is filled. In some sections the growers allow the pickers to set each box on the ground as filled. This is a bad practice if many boxes are filled and exposed to the sun before they are delivered to the packing shed. Some growers furnish laborers for collecting the boxes from the pickers in the field as fast as they are filled, in order to avoid the necessity of so much walking back and forth by the pickers. The larger trays are used to advantage under this method.

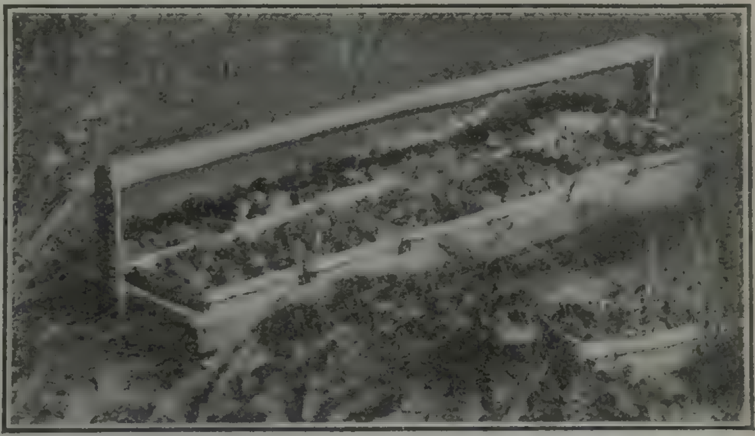


FIG. 5.—A 12-quart tray. This type of tray is too large for convenience, its use results in the berries standing too long in the sun. It is most useful for carrying berries from the field to the packing shed

Picked berries are injured by exposure to the sun, rain, or dust, whether in the field, at the packing shed, or while being hauled to the railroad.

GRADING

Strawberries should be graded, either by hand sorting the individual berries or by classifying the filled boxes. Which of these two methods will prove most satisfactory will depend upon local conditions. In every shipping section growers are found who, by exercising care, grow berries of such uniformly high quality that no hand grading is necessary. This should be the ideal of all growers, as an extra handling adds to the liability to decay.[1] In many instances, however, hand grading is necessary and profitable.

HAND GRADING

Hand sorting or grading consists of separating the undesirable or cull berries from the merchantable fruit. It must be done in the field or at the packing shed. Logically the fruit should be graded by the picker in the field. The amount and the method of hand grading which will secure maximum results will not be the same for all conditions and in all shipping sections, but in most instances it will be found profitable to eliminate the overripe, green, deformed, very small, or otherwise undesirable berries from field-run stock. All leaves, sticks, and other trash are removed at the same time.

Field grading by the pickers causes the least amount of handling, but it is successful only when it is strictly supervised. Pickers, as a rule, do not like to sort the berries while picking. Yet many strawberry growers are successful in having the grading done in the field as he berries are picked by paying pickers for all that are picked but requiring that the cull stock and the merchantable fruit be placed in separate boxes. The separation of the large and small stock might be encouraged by paying more per box for picking the small berries than for the large ones. This practice could be abused by the pickers but proper supervision should regulate it.

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[1] ROSE, D. H. DISEASES OF STRAWBERRIES ON THE MARKET. U. S. Dept. Agr. Circ. 402, 8 p., illus. 1926.
STEVENS, N. E. STRAWBERRY DISEASES. U. S. Dept. Agr. Farmers' Bul. 1458, 10 p., illus. 1925.
——— and WILCOX, R. B. RHIZOPUS ROT OF STRAWBERRIES IN TRANSIT. U. S. Dept. Agr. Bul. 531, 22 p., illus. 1917.

In most of the strawberry sections no grading is attempted except at the packing shed. The method and care with which strawberries are graded at packing sheds vary. A large percentage of the growers do nothing further, even at the packing shed, than to place in crates the boxes of berries as delivered by the picker. A few growers cull out only the green, overripe, decayed, or otherwise undesirable berries found on the tops of the boxes. Others empty the berries from the box in which they are picked into another box and during the process sort out all of the cull berries that are noticed.

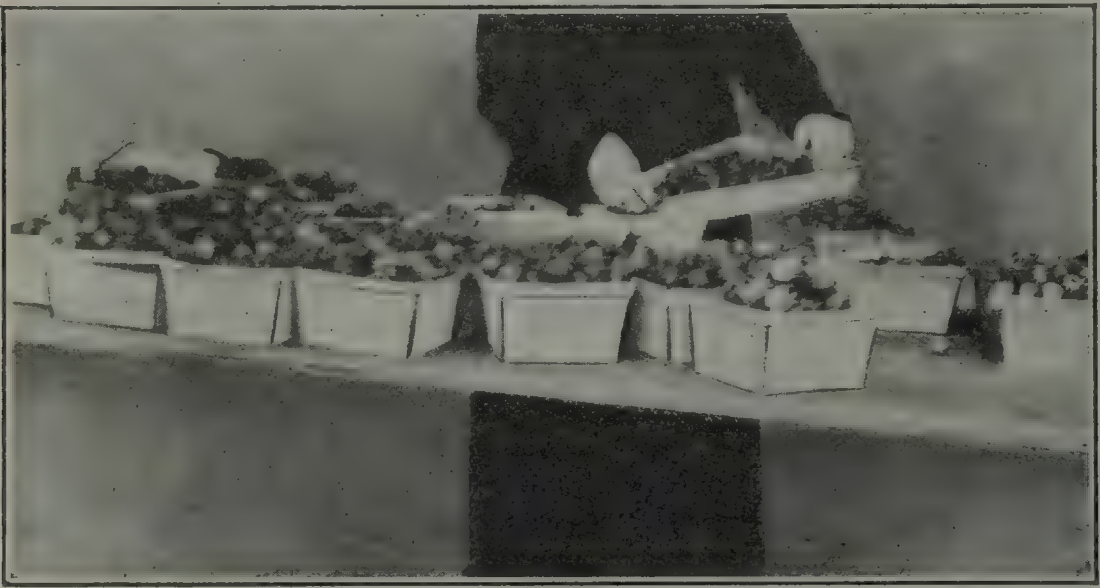

FIG. 6.—"Pan grading" as practiced to some extent in southwestern Missouri

A thorough method of grading or sorting is practiced to some extent in the Ozark berry section, where the principal variety grown is the Aroma. Each box of field-run berries is emptied into a specially constructed tin grading pan (fig. 6), and the undesirable berries are sorted out as the fruit is poured from the pan back into a box. This "pan grading," when done carefully, eliminates all berries considered by the grader to be undesirable.

The success and feasibility of pan grading depends upon the following factors: (1) The variety of the berries; (2) the amount and quality of labor available to the grower; and (3) an adequate price for the graded fruit. Strawberries of the Aroma variety will withstand considerable rehandling and have been pan-graded through several seasons in southwestern Missouri with excellent results. Fruit of tender varieties, or a lot of fruit which, as a whole, is slightly overripe, is damaged materially by rehandling, and the poor condition of the graded berries which have become soft by the time they reach the market more than offsets any extra market value added by grading out the culls at the packing shed.

Successful pan grading depends also upon a sufficient force of intelligent laborers, who work with care and speed. The total expense of this grading includes the cost of picking the culls, the labor cost of grading them out at the packing shed, and the loss in total bulk which results from discarding the culls. The pan-graded product must be sold for a proportionately higher price than the ungraded product, and the grower must receive this adequate increase in price before he will be repaid for his efforts.

CLASSIFYING THE FILLED BOXES

Whether or not the berries are hand graded, they should be classified at the packing shed. This classification should consist of separating the filled boxes according to quality, grade, and size, and placing those of similar value into crates by themselves. It is often true that the boxes of berries from certain parts of the field, or those picked by careless laborers, are of such low quality that if they are mixed with boxes containing berries of high quality they injure materially the value of the entire package of fruit. Some boxes may contain berries of such low quality that they will have to be discarded as culls. Such classification should be based on well-defined standards, and the crates should be marked accordingly, for the benefit of the inspector at the loading shed, the dealers, and the consumers.

STANDARDIZED GRADES

Well-defined standardized grades, properly and consistently used, promote honesty and fair dealing and discourage the careless and unscrupulous packer. They enable the conscientious grower and shipper to realize a premium for care, honesty, and good judgment. They provide a common language with which to describe quality, maturity, size, and all factors that determine the value of a given shipment. They serve as a convenient, fair, and equitable basis for sales, for quotations to buyers, for inspection at shipping points and in receiving markets, for adjustments of claims, for cooperative pooling, for financing, and for the reporting and intelligent comparison of market prices.

The United States Department of Agriculture has formulated grades for strawberries which each year are coming into more extensive use.[2] The terminology used in these grades is the same no matter in what market and what producing section of the United States they may be used. U. S. No. 1 strawberries means the same no matter where the term may be used. Consistent adherence to high standards builds good will and creates confidence.

In the determination of grades for strawberries the factors given the greatest consideration are size and quality.

The size of strawberries varies with the variety and the section in which they are produced. Usually the trade wishes a berry not less than three-fourths inch in diameter. However, as size normally is considered as much as is any other factor in connection with grades, a minimum size should be specified unless it is found that the strawberries meet the specified minimum size requirements of the United States standard grade. It is not practicable to separate all the different sizes of strawberries, as boxed apples or oranges are sized, yet careful attention is needed in order to prevent the packing of boxes that are filled with small berries in the same shipping crates with those of desirable-size berries.

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[2] These Federal grades for strawberries may be subject to slight revision from time to time, and therefore are not given here. Copies may be procured without charge from the United States Department of Agriculture, Washington, D. C.

One of the first requisites for a good grade of strawberries is that they shall be firm enough to carry to market in good condition. The carrying quality, which affects the market value directly, is dependent upon the firmness or degree of maturity of the berries. Overripe berries will not carry well. They usually become soft, or perhaps decayed, moldy, or "leaking" by the time they reach the market. They mar the appearance of the pack and decrease the market value. Immature and green berries also seriously affect the general quality and should be kept out of the boxes.

To obtain reasonably uniform maturity, and a proper degree of maturity, pickings should be made frequently, the frequency depending upon the rapidity with which the berries ripen. Care must also be taken to see that all matured berries are picked. If left on the plants they will be too soft for shipping and will entail a loss when picked.

Berries which are water-soaked or have the least indication of decay should not be shipped. Those which have been bruised, crushed, cut, or otherwise damaged should be discarded. Care should be exercised tc keep out of the pack, as far as possible, berries that are sandy or dirty. Such fruit is of poor quality and is hard to sell. Furthermore, berries that have lost the hulls should not be placed in the package.

Varieties have characteristic appearances, sizes, and carrying qualities and berries of only one variety should be placed in a box or crate. There is little occasion for a mixture of varieties, as they usually are grown in separate rows. Picking supervision is all that is needed.

The multiplicity of grade names such as "Fancy," "Choice," "A," "B," "Firsts," and "Seconds" creates confusion. It is the purpose of the United States Department of Agriculture to standardize the names of the grades as well as the grades themselves.

Every shipping section needs uniform grades, and it is believed that the grades promulgated by the department will supply these needs. Strawberry-shipping associations need the grades as a guide for their growers in preparing the crop for market and as a basis of inspection. The need is even greater where the growers are unorganized. Buyers, both at the shipping point and in the market, should have a definite basis upon which to make their purchases. The value of standard grades depends upon their specifications and the extent to which the growers and shippers adhere to them.

PACKING

Strawberry boxes, when properly filled, are neither slack nor so full that the berries are likely to be crushed; they are full enough to look attractive and they are still well filled after being transported to the market and sold and delivered to the consumer. At the same time there is danger of filling the boxes so full that the cover will crush many berries. Usually growers fill their boxes well, but there are still a few who appear to think they can save berries by slack packing, and thus increase their own profits. The grower who does this loses eventually. Slack-packed berries are as difficult to sell as those which are beginning to decay. The box must contain no leaves, sticks, or other trash. Boxes in the second, third, or fourth layer of the crate must be as well filled as those in the top layer.

Some sections cling to the practice of "facing" or placing the berries in the top layer on their sides, all pointed one way (fig. 7), or placing them with the stem of the berry down, in order to add to the attractiveness of the package. This makes an attractive package of fruit, and there seems to be no harm in the practice until the tendency to "top," or to put the best berries on the face of the box creeps in. Many shipping associations claim that unless strawberries are very high in price, the extra labor cost of "facing" the boxes of berries is not warranted. "Topping" or placing the best berries in the top layer of the box and the poorer or smaller berries in the bottom of the box should not be practiced. The face of a box of berries should be a fair sample of the entire contents of the box, and the contents of the top boxes in a crate should represent fairly the entire contents of the crate.

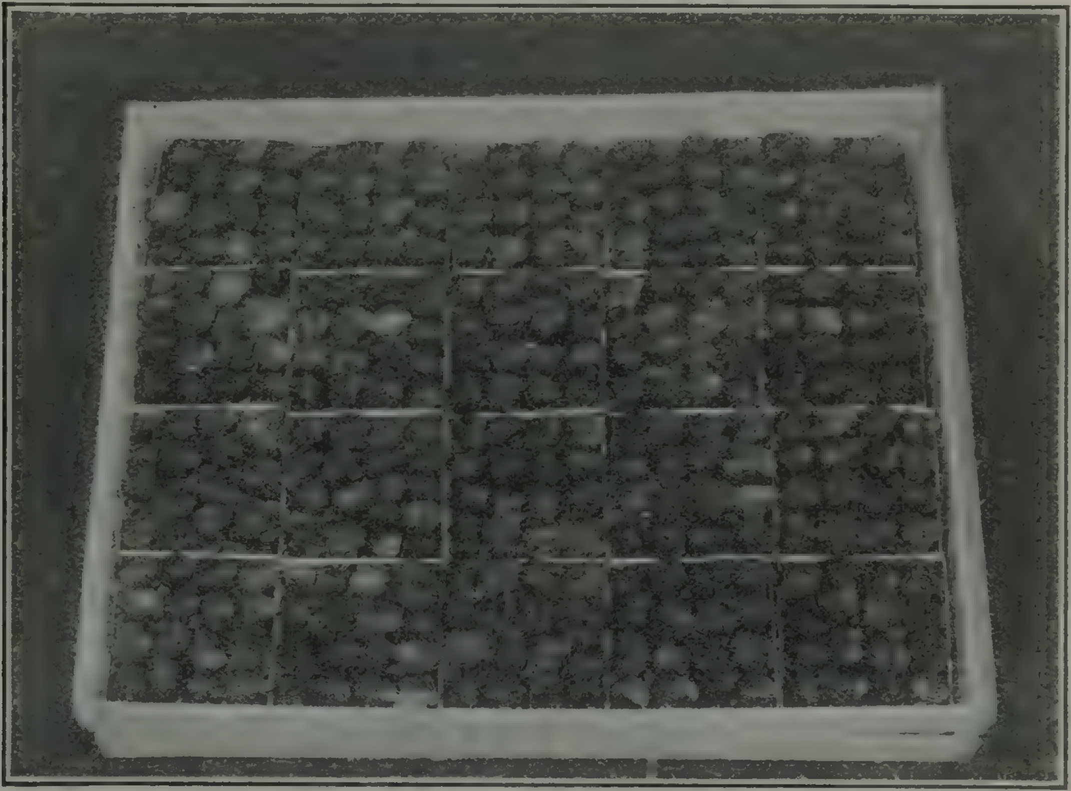

FIG. 7.—A 20-pint crate of California strawberries. The berries have been "faced" in packing

Strawberries should be graded, packed, hauled to the station, and placed under refrigeration as soon as possible after picking. Vehicles for hauling the berries to the railroad station should be equipped with springs, and should be provided with a canvas, tarpaulin, or other form of cover to protect the berries from the rain, sun, and dust.

PACKING SHEDS

MANAGEMENT

Careful supervision at the packing shed by the grower, a member of his family, or a reliable employee, is of vital importance if a satisfactory grade and pack is to be secured. It is especially necessary if the field supervision is incompetent or if the berries are to be graded or classed at the packing shed.

Work at the packing shed includes receipting for the berries delivered by the pickers, grading or classifying, packing, placing boxes in the crate, marking, and nailing on the covers. When the acreage is small, all of this work may be performed by the grower or some member of his family, but when the acreage is large, frequently one person's time is occupied in receipting for fruit delivered by the pickers. Some growers have this person act in the capacity of inspector to note the quality of the berries delivered by each picker, and to note whether the boxes are properly filled. The number of laborers required at the packing shed will depend upon the quality of the berries, the thoroughness of the grading, and the number of pickers in the field.

LOCATION AND PLAN

The location of the packing shed with reference to the berry field is important. If it is properly placed, only a minimum amount of walking is necessary for the pickers to deliver their berries, and the temptation to walk across the rows to reach the shed is removed. A location at the ends of the rows near the center of the edge of the field is satisfactory for a small field. For larger fields, a path may be laid off at right angles to the rows near the middle of the field, and the packing shed located at one end of, or on, this path. With this arrangement the pickers can be required to walk between the rows to the central path to reach the shed. A location convenient to the farm road is desirable.

Packing-shed facilities vary from the shade of a tree to a tent, a temporary shed, or a well-built, permanent shed. Expensive, permanent sheds are exceptional. The most common type is a cheaply constructed, board-roofed shed with or without boarded sides. There are many reasons for the predominance of the cheap shed. Strawberry fields normally are not profitable for many years in succession, and the largest number are not profitable after the second or third year. It has been a common practice in some berry sections to use only newly cleared land each time a new plantation is set. For these reasons it is necessary to change the location of the sheds frequently. Some growers prefer to have two or three conveniently located temporary packing sheds rather than one permanent shed, which can not always be located so conveniently. As the season is short the sheds are used but a short time. Some growers prefer to erect a temporary structure just before the harvest begins and take it down at the end of the strawberry-picking season. A temporary shed is best adapted to the usual conditions. Where the soils are more fertile, however, and the fields in which the strawberry crop is used as a part of the rotation are closely grouped, a permanent packing shed is advisable.

The convenience of the packing shed depends largely upon the plan from which it is built. The plan shown in Figure 8 is good. The cheaply constructed shed shown in Figure 9 approximates this plan. All pickers are required to enter one end of the passageway shown at the front of the shed. An inspector who receipts for the boxes of berries delivered by the pickers stands at the entrance of this passageway. The pickers place the filled boxes on the receiving table and walk through to the other end of the passageway, where they obtain a supply of empty boxes. The back portion of the receiving table is used as the grading and packing table. Benches, upon which empty crates are placed for filling, are at a convenient distance from the packing table. Back of the packing table a solidly built bench is provided upon which the filled crates are placed for nailing. Plenty of space is needed to stack the filled crates so that they will not be exposed to the sun, and to keep a supply of empty crates. In the more expensive sheds storage space for empty crates is provided in the second story. There should be a free circulation of air in the packing shed for the comfort of the packers and for the ventilation of filled crates.

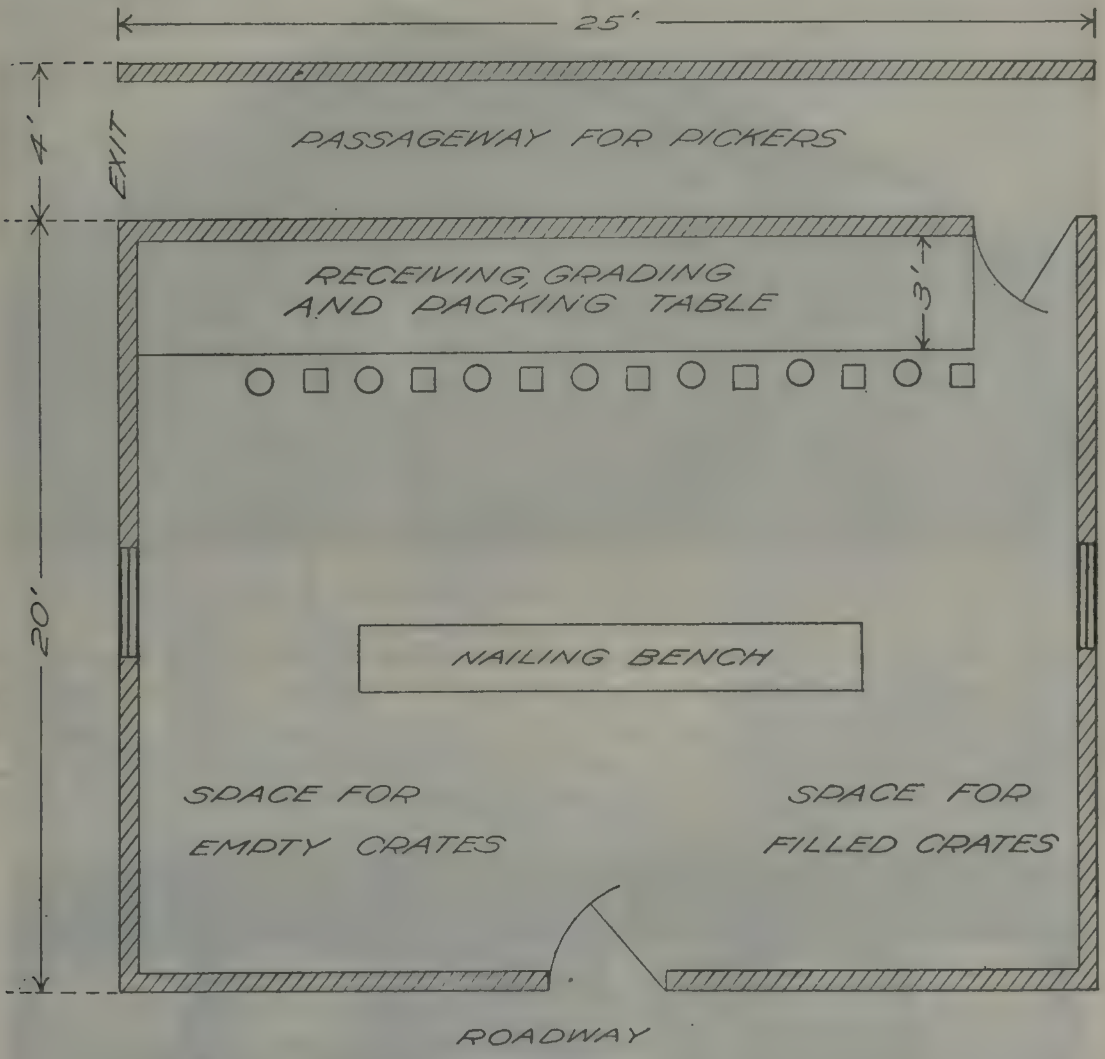

FIG. 8.—A simple yet satisfactory plan for a strawberry-packing shed

CONTAINERS

The small containers in which strawberries are marketed are known as boxes, baskets, cups, or tills. In this bulletin they are termed "boxes." Through the United States standard container act [8] three legal sizes for interstate shipment have been established for these boxes. The legal sizes are the quart, pint, and one-half pint based on dry measure. There is no fixed standard dimensions; any shape of box can be used, therefore, if its capacity meets the legal requirements. The several different types now in use are the American, Hallock, Leslie, metal rim, stitched tray, and paper. (Fig. 10.) Of these the American is the most generally used.

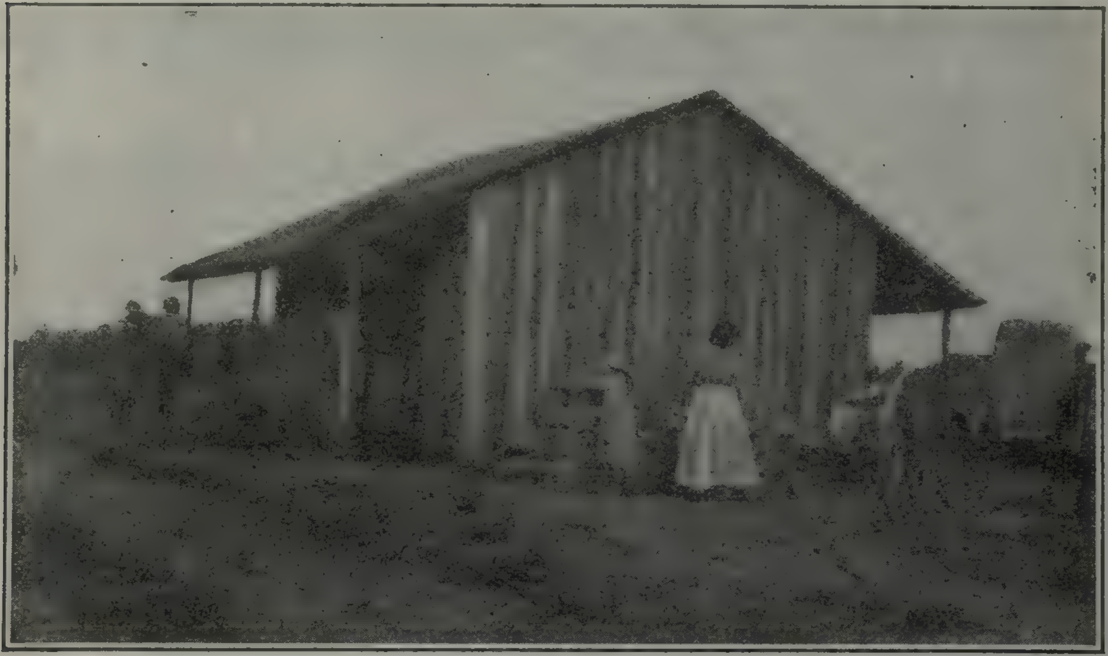

FIG. 9.—A strawberry-packing shed built from a plan similar to that shown in Figure 8

FIG. 10.—From left to right: The American, metal rim, Hallock, Leslie, stitched tray, and paper strawberry boxes

The American is the most popular type east of the Rocky Mountains. The Hallock is generally used in Michigan, southern Indiana, southern Illinois, Oregon, and Washington, but the American is used also to some extent. The use of the Leslie is confined mostly to southern Illinois and to parts of Iowa, Nebraska, Kansas, Missouri, and Colorado. The stitched tray in the quart size is used in the districts surrounding St. Louis, and the pint size is used in California. The metal-rim type in the quart size is used in the East and the pint size in California. There are various styles of paper boxes. The American, Hallock, and Leslie shapes in all three of the legal sizes, have been used to some extent in the East. A stitched-tray type, in the pint size, is used in California.

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[8] The following publication, containing the law and the regulations for its enforcement, may be obtained from the Office of Information, United States Department of Agriculture: UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF AGRICULTURAL ECONOMICS. RULES AND REGULATIONS OF THE SECRETARY OF AGRICULTURE UNDER THE UNITED STATES STANDARD CONTAINER ACT OF AUGUST 31, 1916. U. S. Dept. Agr., Bur. Agr. Econ. Serv. and Reg. Announc. 104, 4 p. 1927. (Revised ed.)

Most of the berries marketed in the eastern half of the country are packed in the pint and quart boxes. Only pint boxes are used on the Pacific coast.

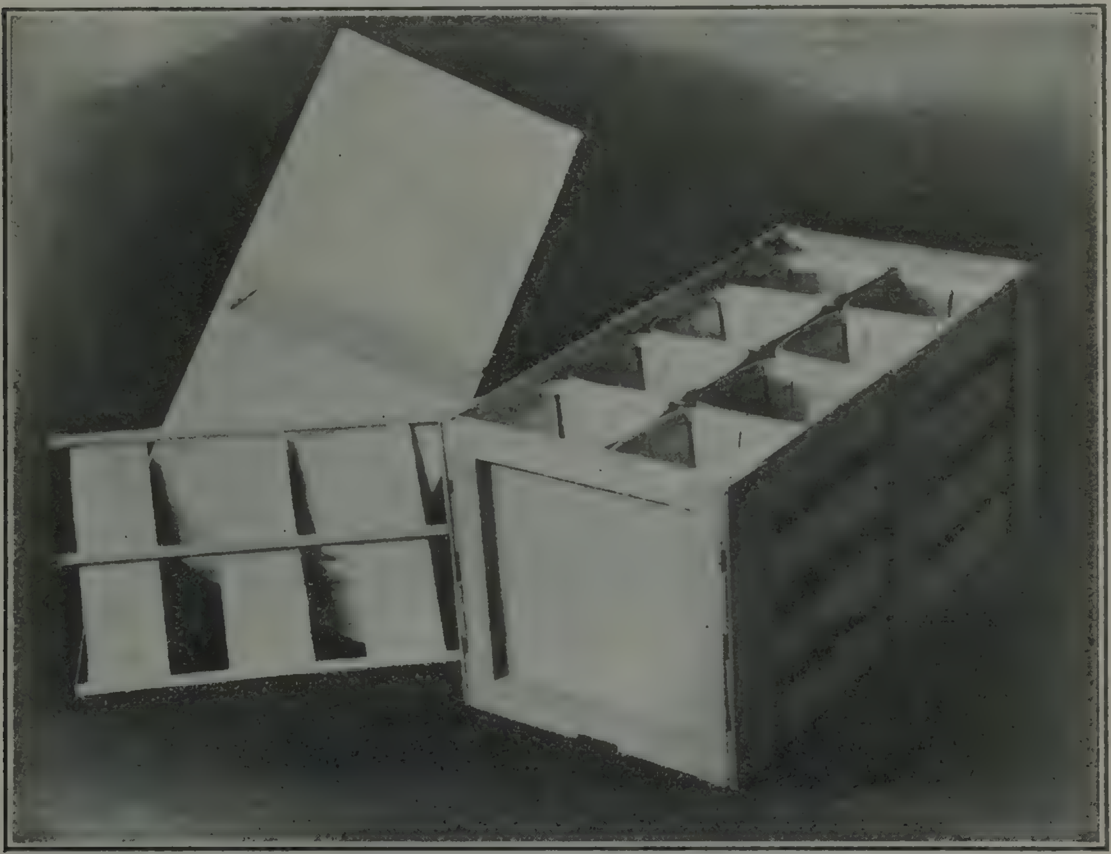

FIG. 11.—The American ventilated crate—a popular and satisfactory type of package for strawberries.

SHIPPING PACKAGES

Three types of crates, each constructed to accommodate a different shape of box are most commonly used for shipping strawberries. These are the ventilated or American crate (fig. 11) containing 24 pints, or 24, 32, 48, or 60 quart boxes; the Hallock crate containing 16 or 24 quarts, or 16 or 24 pints; and the Leslie crate containing 24 pints or 24 quarts (fig. 12).

The crates in most general use for strawberries contain 24 or 32 quart boxes. The American crate of the 24-quart size is used in Tennessee, Missouri, Kentucky, Arkansas, and Texas and in the St. Louis districts for the stitched-tray quart boxes. Louisiana uses the 24-pint American crate for early strawberries and the 24-quart crate to some extent for the later fruit. The 32-quart American crate is used in Florida, the Carolinas, Virginia, New York, Maryland, and Delaware. The last two States formerly used a number of 48-quart crates and in the section of Norfolk, Va., the 60-quart crate is still used to some extent. This type of crate is made in two styles. One has a nailed top and the other has a hinged top which is fastened with a hasp (fig. 13), making inspection less difficult. The latter style is used chiefly in the Atlantic Coast States. The metal-rim quart boxes, as well as the American boxes, are used in all the quart crates mentioned above.

The Hallock crates, containing 16 or 24 quarts, or 16 or 24 pints, are used in Michigan, Illinois, and Indiana. In Oregon and Washington those holding 24 pints are used.

The Leslie crate holds either 24-pint or 24-quart boxes and is used in southern Illinois, parts of Iowa, Nebraska, Kansas, Missouri, and Colorado.

Several types of folding ventilated crates have been used to a greater or less extent. One is now being used in some parts of Tennessee and Arkansas. (Fig. 14.)

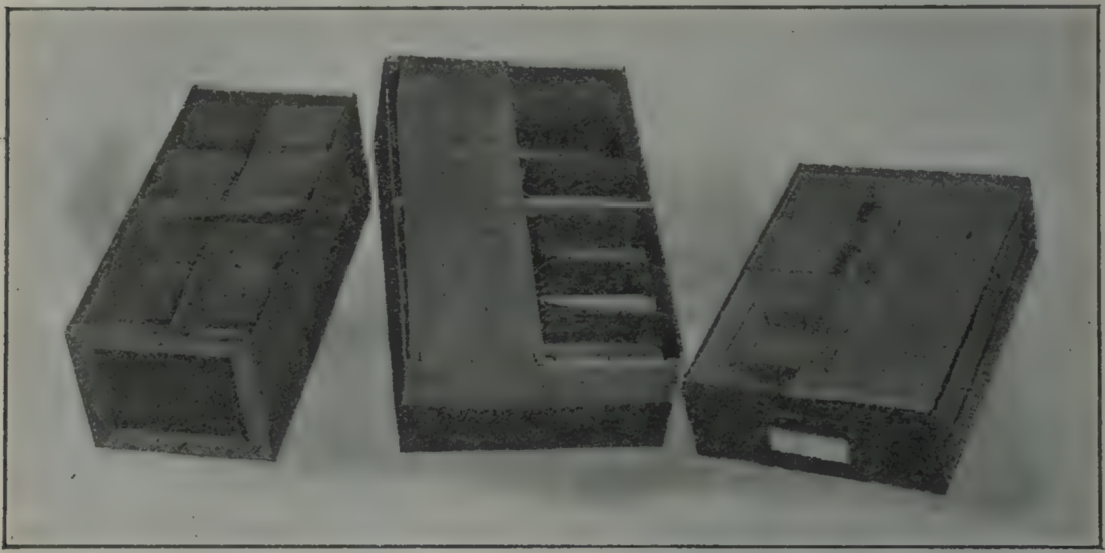

FIG. 12.—Strawberry crates: 16-quart Hallock (left); 24-quart Leslie (middle); 24-deep-pint Hallock (right)

In California a tray which holds 12 or 15 pint boxes of either the metal-rim or stitched-tray type is used. To some extent an old and unique form of chest which holds 16 or 20 trays (fig. 15) is used also; each tray holds 6 pints. The California chest is a returnable package and is gradually going out of favor.

Clean, neat, properly nailed crates constructed of material strong enough to insure the safe delivery of the fruit to the market are best. Soiled or secondhand crates injure the sale of the berries, as the difference in appearance on the market between a new, clean package and a soiled or secondhand package ordinarily will make a sufficient difference in price to compensate for any saving in cost from using the soiled package.

Pony refrigerators (fig. 16) are used extensively in Florida for early express shipments to northern markets. They are heavy cases holding from 64 to 80 quart boxes. The layers of boxes are separated by dividers of the type used in the ordinary crates. Metal trays are built through the center or in the top, or both, to hold a supply of ice. Air-tight covers are clamped on after the berries and ice are in place.

These pony refrigerators are well adapted to long-distance express shipments when it is not possible to load in car lots and when prices are high. An occasional objection is made that the ice pans sweat and allow water to drop on the berries, causing injury. These refrigerators are not gift packages and must be returned to the owner after being emptied.

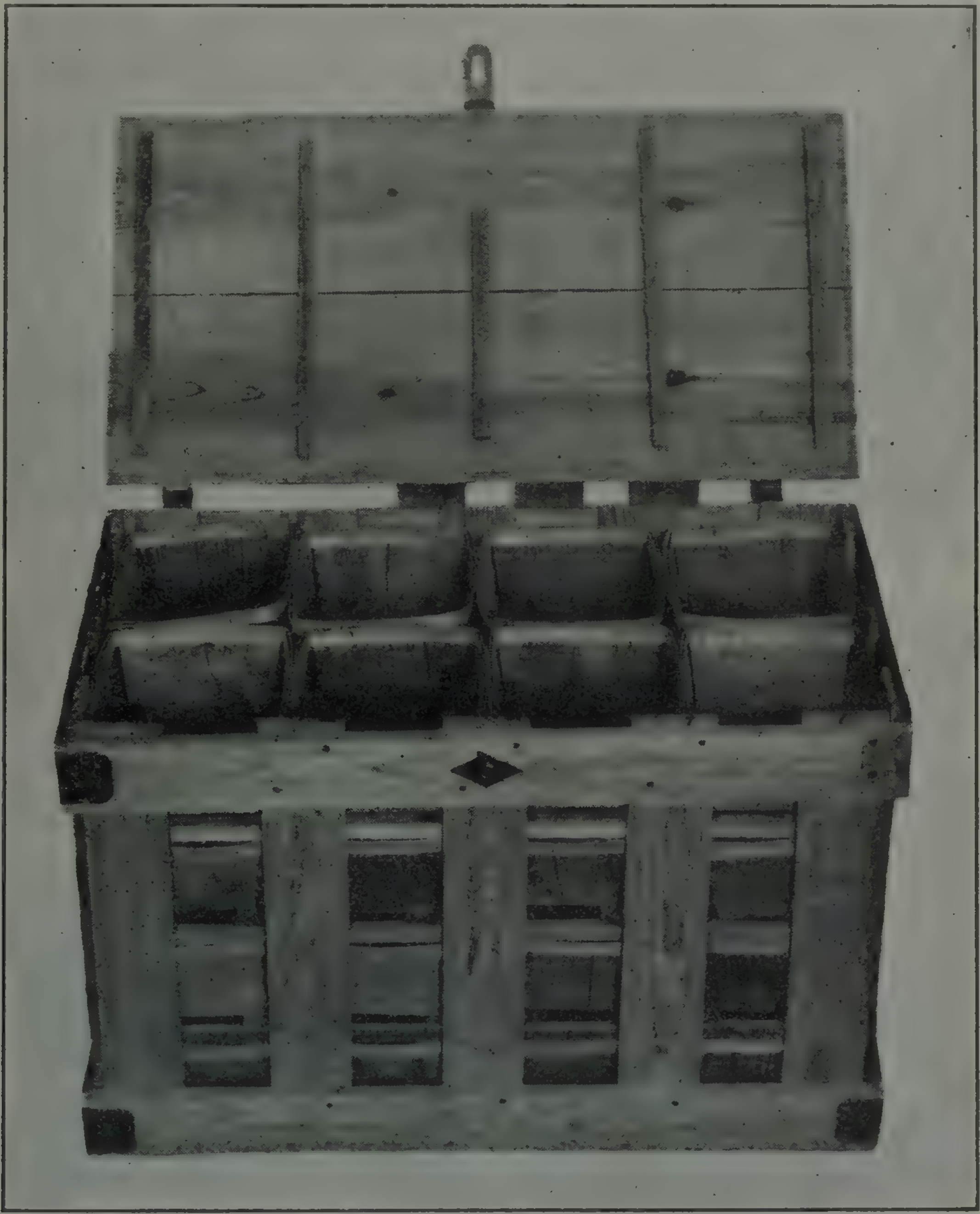

FIG. 13.—American strawberry crate of the hinged-top type

BRANDING AND MARKING

Many strawberry-shipping associations use brand labels which are pasted on the ends of the crates. (Fig. 17.) This is good practice for an association which wishes to build a reputation for its berries. The labels need not be expensive. To comply with the net-weight amendment of the Federal food and drugs act, a statement of the quantity of its contents must be marked plainly on the outside of each crate. This statement of contents must be in terms of the largest unit contained in the package—pints or quarts. The usual statement is similar to the following: "This crate contains 24 dry quarts," or "Contents 24 dry pints." In addition to this mark, the shipping associations usually require that the crate be stamped with the name of the variety of the berries, the grade, and the grower's name and address. When berries are marked in this way, it is easy to trace complaints of carelessness, or fraudulent packing, back to the grower who is responsible. It adds to the appearance of the

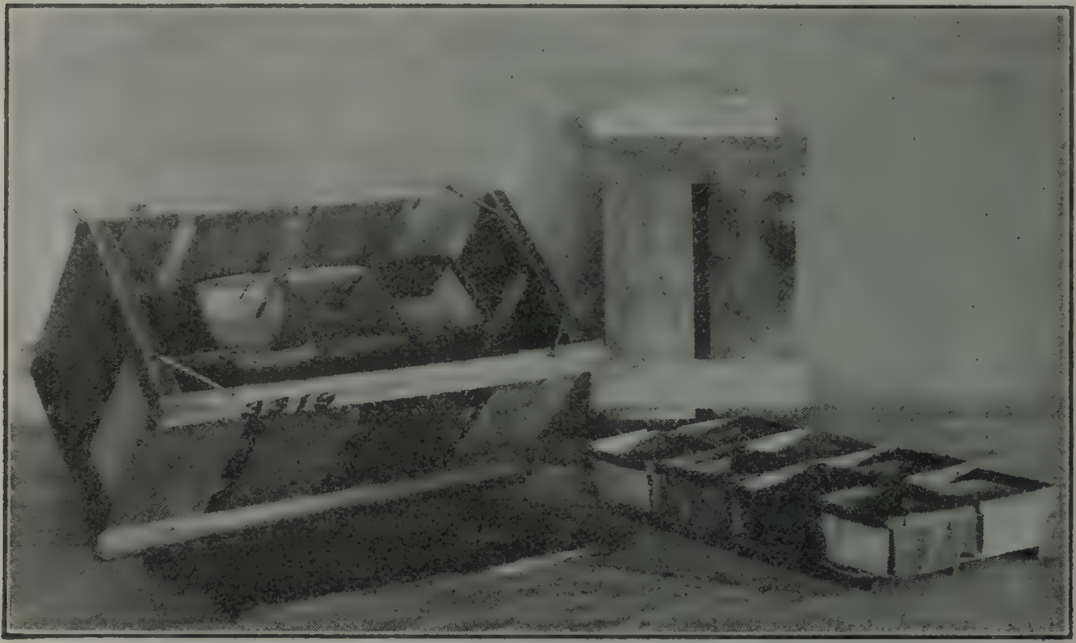

FIG. 14.—A type of folding ventilated strawberry crate

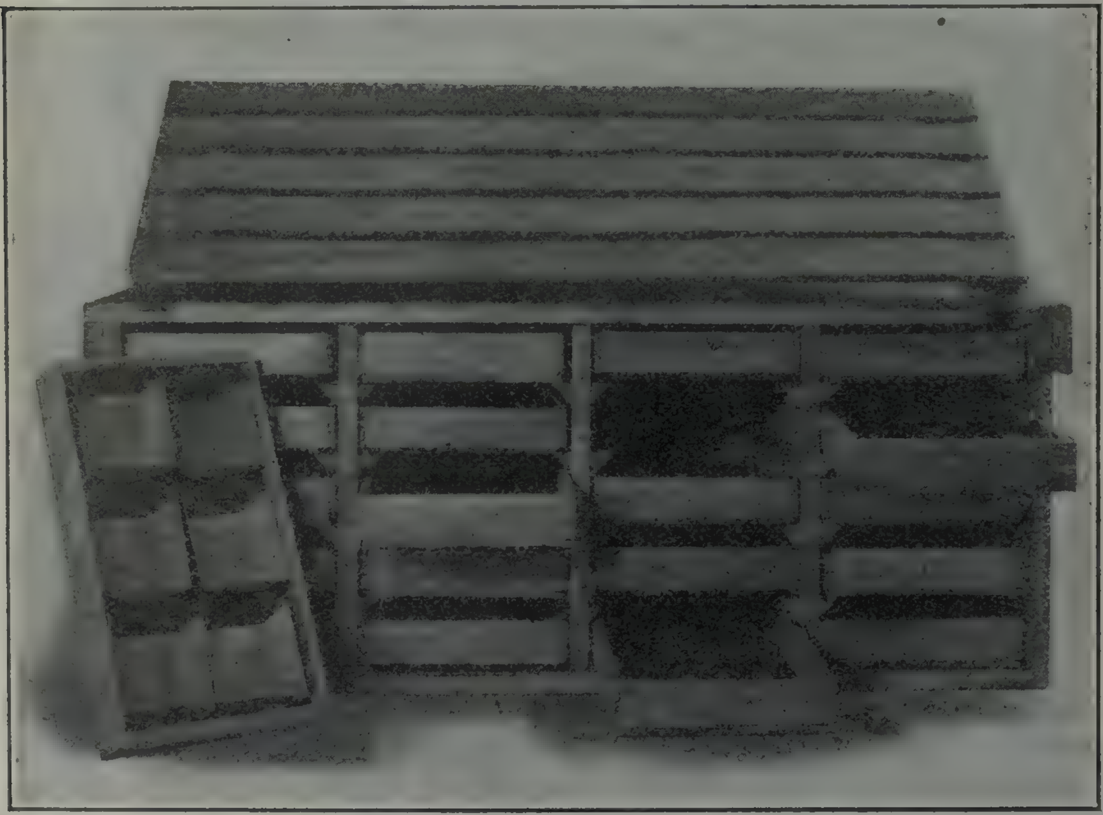

FIG. 15.—The California chest, used for shipping berries a short distance to San Francisco. It is returned to the shipper

package if the markings are arranged neatly in the upper left-hand corner of one end of the crate. Marks made with rubber stamps or stencils are more attractive than pencil, crayon, or similar markings.

INSPECTION AND LOADING SHEDS

An important factor which affects the success of a shipping association is a rigid system of inspection at the loading point. (Fig. 18.) It is essential in building up a strong marketing organization because without it no association can be sure of shipping a dependable, standardized product. An efficient organization will have its own staff of inspectors who are responsible to some individual who has in turn been made responsible for the grading and packing for the organization. Association inspectors obtain the best results by spending part of their time among the pickers, packers, and growers, showing them just what is required in putting up a good grade of fruit and how improvements can be made.

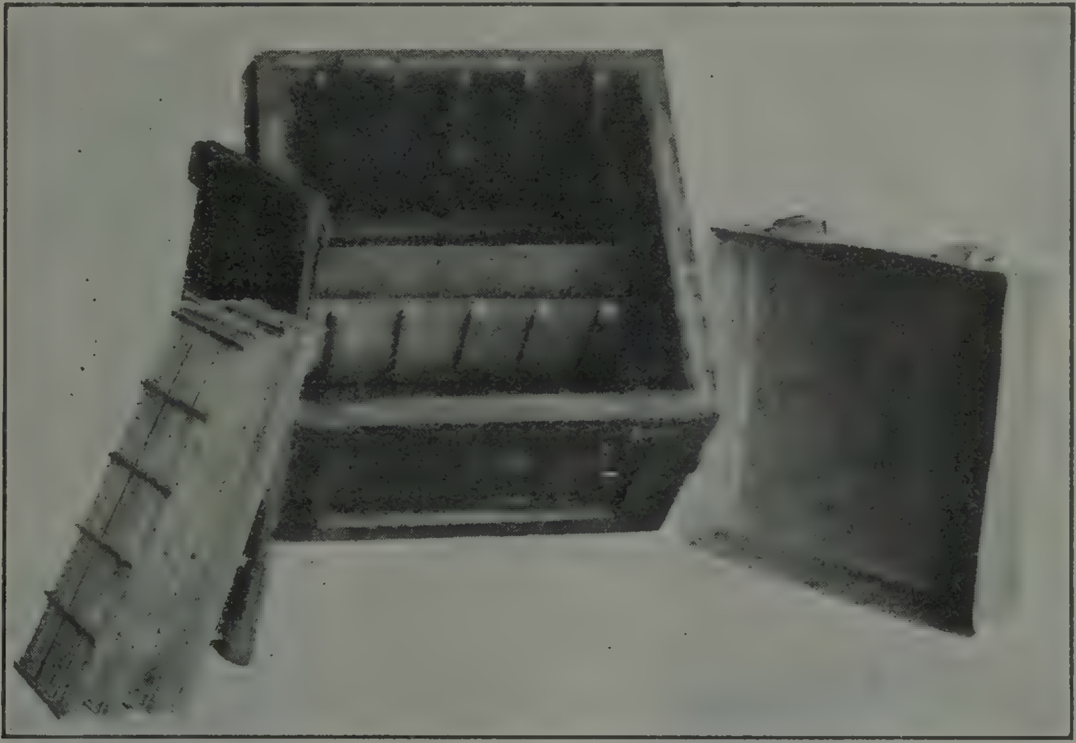

FIG. 16.—Pony refrigerator used extensively by Florida strawberry shippers

Raising the standard of strawberry grading and packing methods in a given community must be regarded as an educational process. Perfection can not be attained at once. Many details present themselves during the season which will call for patience on the part of the growers, the inspectors, and those responsible for the pack. If the work of grading and packing is to bring financial returns, growers must cooperate in packing grades of strawberries which the trade will recognize as always uniform and dependable. Any inspection system is fundamentally wrong which does not make it possible for the grower with well-packed high-grade berries to secure more for his stock than another who delivers inferior, poorly graded stock. Proper discrimination by shipping associations encourages better grading and packing.

Ineffective efforts toward cooperation frequently result in the presence of two or more associations at a shipping station. In such instances, when the inspection begins to be really effective in one association, some of its grower members are not willing to pack their fruit according to the established grades, and so deliver their berries to another association which has a less effective inspection service. Such growers fail to realize that they are members of an association formed for their mutual benefit and that the management should have their constant support.

The main factors considered by inspectors are size, degree of ripeness, cleanliness, and the proper filling of the crates. The degree of ripeness at which strawberries are accepted for shipment in carload lots depends upon the period of the shipping season and the weather which prevails at picking time. During cool, dry weather, berries may be accepted in riper condition than during hot damp weather.

Adequate loading sheds are of much benefit in almost any shipping section, both to growers and to shippers, besides providing a place for effective inspection. In some of the strawberry-shipping sections of Arkansas, Missouri, and Tennessee specially built loading sheds may be found at the shipping points. (Fig. 19.) These sheds usually are built by the railroads, but in a few instances the shipping associations own their loading sheds. They are so built that it is possible to load one or more cars at a time; the number varies according to the importance of the shipping point.

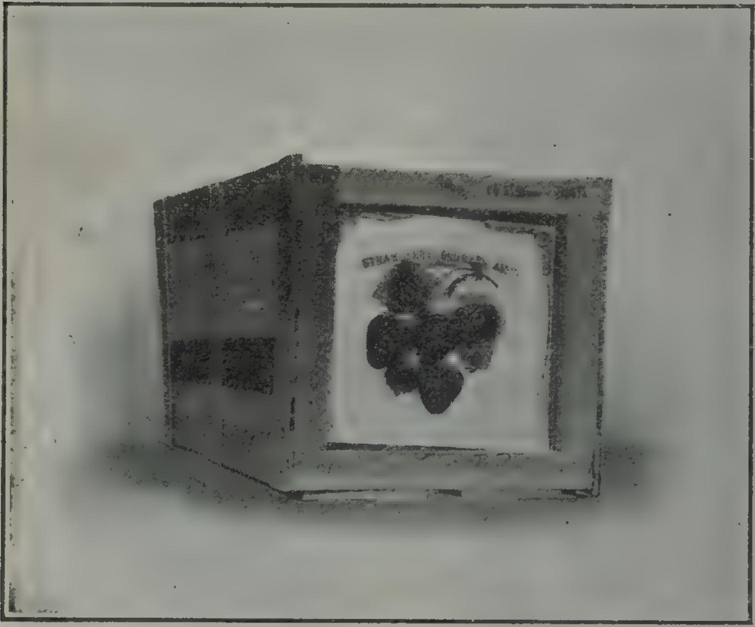

FIG. 17.—A brand label. The illustration also shows the ordinary method of marking the crate with variety, net contents, and grower's name and address.

In parts of the Ozark section each grower's strawberries are inspected at the loading shed before they are placed in the car. The sheds are equipped with benches or tables upon which the filled berry crates are unloaded for the convenience of the inspector. At one point a double row of tables is provided. After the crates are inspected and marked, they are shifted to the second or back table; here the covers are replaced and the crates are loaded in the cars. Careful fastening or nailing of the covers after inspection is necessary so that the crates will carry well and present an attractive appearance on the market.

Usually the grades, as classified by the inspector, are marked on the crates or are indicated by a brand label pasted on the end of the crate. The different grades or brands are then loaded separately in the car or are loaded in different cars, and the grower is given a receipt which shows the number of crates of each grade he has delivered. A duplicate receipt is retained by the association. Careful marking and separating tend to inspire confidence in grades or brands and to facilitate handling and marketing. Where no loading shed is available the inspections are made on the truck or wagon or at the car door.

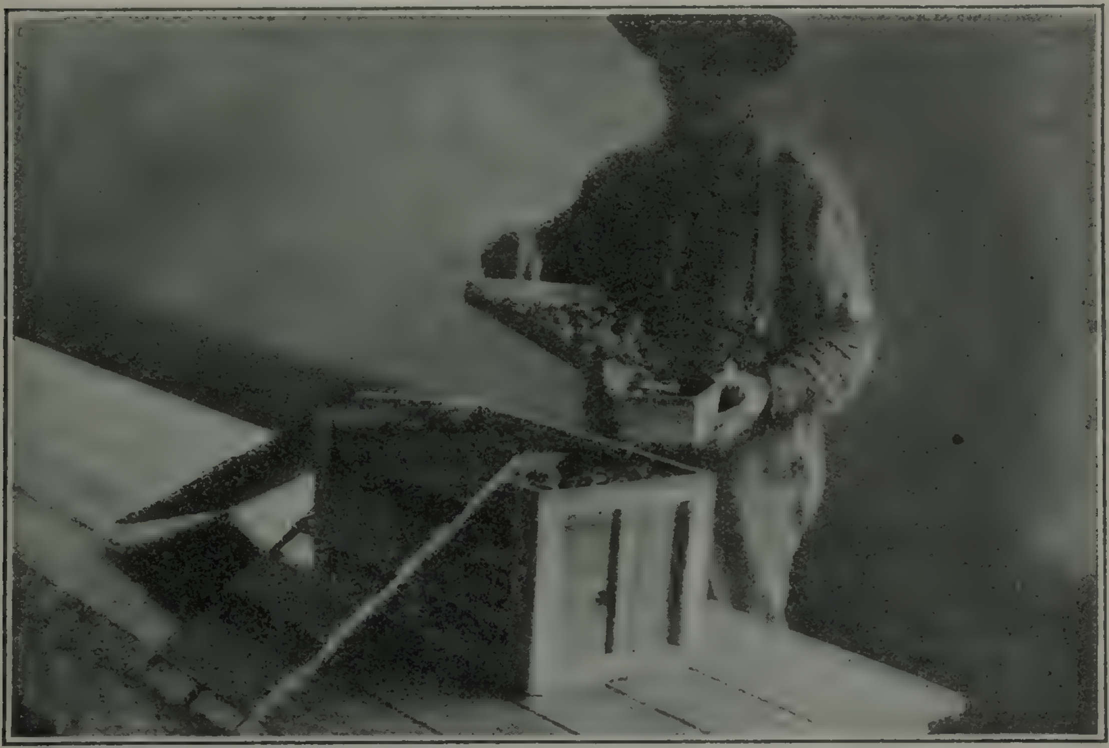

FIG. 18.—Inspecting the strawberries as delivered to the loading shed or platform

The inspection practiced by some associations is very thorough and of great value in keeping up the standard of their pack. Others have allowed the inspection to degenerate into a mere form without value. Thorough inspection serves to eliminate deception and dishonest packing; it serves to encourage the production of high-quality fruit and to reduce waste by preventing the shipment of inferior fruit.

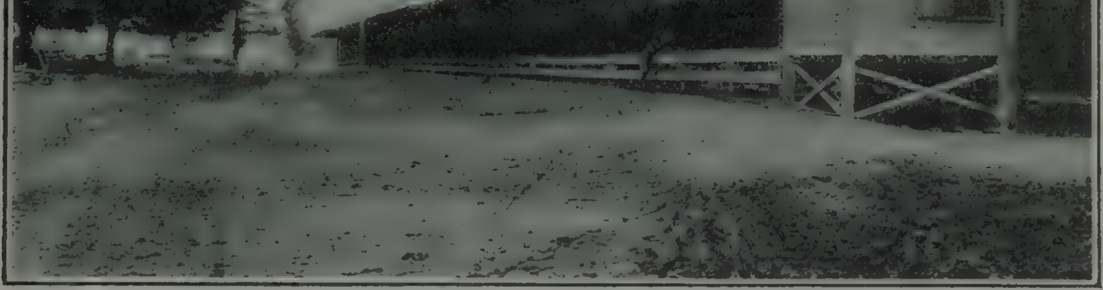

FIG. 19.—A strawberry loading and inspection shed

A Federal-State shipping-point inspection service is now available in most of the strawberry-shipping sections. This work is usually under a cooperative arrangement between Federal and State authorities. Upon request of the grower, shipper, receiver, or any other person who has a financial interest in any lot of fruit an inspection is made of the contents of a car and a certificate is issued which describes in detail the quality, condition, grade, pack, load, and other important factors. This certificate is receivable as prima facie evidence in any United States court; it is generally accepted as a basis of buying and selling, and is used as a basis of settlement for allowances or rejections, and in connection with insurance and the settlement of claims. The service is entirely optional and the cost is nominal as it is only enough to cover the expense involved. The inspectors who operate in this service are not financially interested in the product they inspect. They are under Federal supervision and are responsible only to their supervisors.

The inspectors usually work on the loading platform or in the car while it is being loaded. Usually a casual examination is made of every crate in each lot of strawberries delivered to the car, to note the uniformity of the lot, and a thorough examination is made of representative samples of each lot.

LOADING CARS

The importance of efficient car-loading and bracing methods can not be overemphasized. The loading must be so planned as to be compact and still provide for proper circulation of cold air between the crates.[4] The crates are loaded in stacks across the car with the long side parallel to the side of the car, sufficient space being left between the rows to allow for air circulation.

To prevent side swaying and shifting, each layer in the stack must be securely stripped crosswise of the car with 8-foot strips about 1 inch thick; two strips should be nailed to each layer, one to the front end and one to the back end of each crate. One end of each strip should rest against the side of the car alternating from one side to the other with each strip.

After the car is properly loaded it is imperative that the load be braced securely, particularly when space is left vacant at the doorways. In such cases center bracing is used. Center-bracing gates, made with uprights in front of each row of crates, and two or three crossbars at appropriate heights, are spread or wedged apart by cross braces until the entire load is made tight. These cross braces are cut somewhat longer than the distance between the upright gates or frames and are driven into place and nailed. An examination of cars at market terminals shows that considerable damage in transit is incurred through inadequate or carelessly installed bracing. Inadequate bracing is usually due to the wish to save expense by using a small amount of lumber but this often proves to be poor economy.

Table 1 indicates the range and approximate number of strawberry crates usually loaded in a car.

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[4] RIDLEY, V. W. FACTORS IN TRANSPORTATION OF STRAWBERRIES FROM THE OZARK REGION. U. S. Dept. Agr., Bur. Markets Doc. 8, 10 p., illus. 1918.

TABLE 1.—*The range and approximate number of strawberry crates usually loaded in a car.*

State	Containers	Range of number of packages per car	Approximate number of packages usually loaded per car
Kansas, Louisiana, Oregon, Texas, Utah, Washington	24-pint crates	650–800	720
Wisconsin	16-quart crates	600–800	720
Michigan	do	500–800	650
Alabama, Arkansas, Florida, Illinois, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, Texas	24-quart crates		[1] 420 [2] 448
Delaware, Maryland, New Jersey, New York, Virginia	32-quart crates	175–300	240
North Carolina, South Carolina	do	200–240	232
Florida	do	175–196	175
Delaware, Maryland, Virginia	60-quart crates	128–160	
California	Trays (pint boxes)	1,200–1,400	1,200

[1] Freight shipments.
[2] Express shipments.

SHIPMENT BY MOTOR TRUCK

In localities in which conditions are favorable the shipment of strawberries by motor truck is rapidly replacing rail shipment. Truck shipments are limited, to a considerable degree, to regions relatively near the markets, where the greater part of the distance covered is over good roads. Usually rail shipments necessitate loading the fruit at the packing shed, hauling it to the shipping point, unloading at the platform, and placing in the car. On completion of the journey by rail it is usually loaded into trucks and hauled to the markets. Strawberries intended for shipment by truck are usually collected at some central point and are there loaded on trucks which move direct to market, thus avoiding much handling. Because of this direct movement, shipment by truck in many instances consumes less time than is required for rail shipment and when made over reasonably good roads the strawberries arrive at their destination in excellent condition.

Under ordinary conditions trucks should be loaded late in the day and the trip so arranged that they will arrive at their destination about midnight or in the early morning hours. If the journey is made during the night, when air temperatures are lowest, the load will be well cooled en route.

There is no standard method of loading a truck with strawberries. The types and sizes of trucks vary to such a degree that it is a matter for the individual truck owner or driver to know just how to load to carry his shipment safely. Snug, tight loading without injury to the contents of the package is the rule that should be followed. All loads should be protected from dust and moisture by some form of covering.

SUMMARY

The best of marketing facilities can not overcome the handicap of inefficient picking, grading, and packing methods. The unsatisfactory condition and grade of strawberries often found on the markets indicate a need for more attention to standardization and for better handling methods.

The first step in the preparation of strawberries for market is to engage an adequate supply of competent, dependable labor before the picking season begins.

It is necessary to provide competent supervision for the pickers before they are sent into the berry field.

The proper stage of ripeness for harvesting strawberries as determined by color depends upon the variety and the distance to be shipped, but it varies from about three-fourths colored to a full-red color. Growers and shippers who trace occasional shipments to market can determine whether the fruit is being delivered to dealers in the best possible condition as to ripeness.

The best picking is done by the use of the thumb and forefinger, each berry being pinched off with a stem about three-eighths to one-half inch long and carefully placed. Berries should not be snatched off and tossed or thrown into the boxes. Many pickers need instructions as to the proper method of picking.

Trays for carrying the berry boxes into the field are best when they are light in weight but substantial, medium in size, and so built that the boxes fit into them snugly.

Exposure to the sun, rain, or dust in the field, at the packing shed, or while being hauled to the loading station will injure the picked strawberries.

Under most conditions the removal of undesirable berries from field-run stock will be as much hand grading as will be found practicable. Avoidance of unnecessary handling is advisable.

Whether or not the berries have been graded, the filled boxes should be classified as to quality before they are placed in crates for shipment.

Depending upon conditions, strawberries may be graded either in the field by the pickers or in the packing shed by special labor. Field grading by pickers reduces handling.

Fixed, uniform strawberry grades are very desirable as a guide and basis for the use of growers in preparing their crop for the market, of buyers in the purchase of fruit, and of inspectors at the point of shipment or destination.

The important factors considered in standardized strawberry grades are size and quality.

Boxes should contain a uniform grade of berries and should be so filled that they are not slack nor yet full enough for the berries to be crushed. It is advisable to place the fruit under refrigeration as soon as possible after it is packed.

Careful supervision at the packing shed is of vital importance; so also is the location and plan of the packing shed.

The crates in most general use for strawberries contain 24 or 32 dry-quart boxes. Crates holding 16, 20, 24, 30, or 32 pint boxes and 16, 48, or 60 quart boxes also are used. New, clean, attractive, strongly made crates are best. The selling price of berries is affected when they are offered for sale in damaged or unattractive packages.

Growers and shipping associations who desire to build a reputation for well-standardized grades of berries sometimes use brand labels pasted on the ends of crates to good advantage. The Federal food and drugs act requires that all crates of berries be marked with a statement of the quantity of the contents. If the variety, the grade, and the grower's name and address are also neatly marked, the prospective buyer will have confidence in the product.

A rigid system of inspection at the loading stations is a prerequisite to the permanent success of shipping associations.

Most of the strawberry-shipping sections would be benefited greatly by adequate sheds for car loading and inspection.

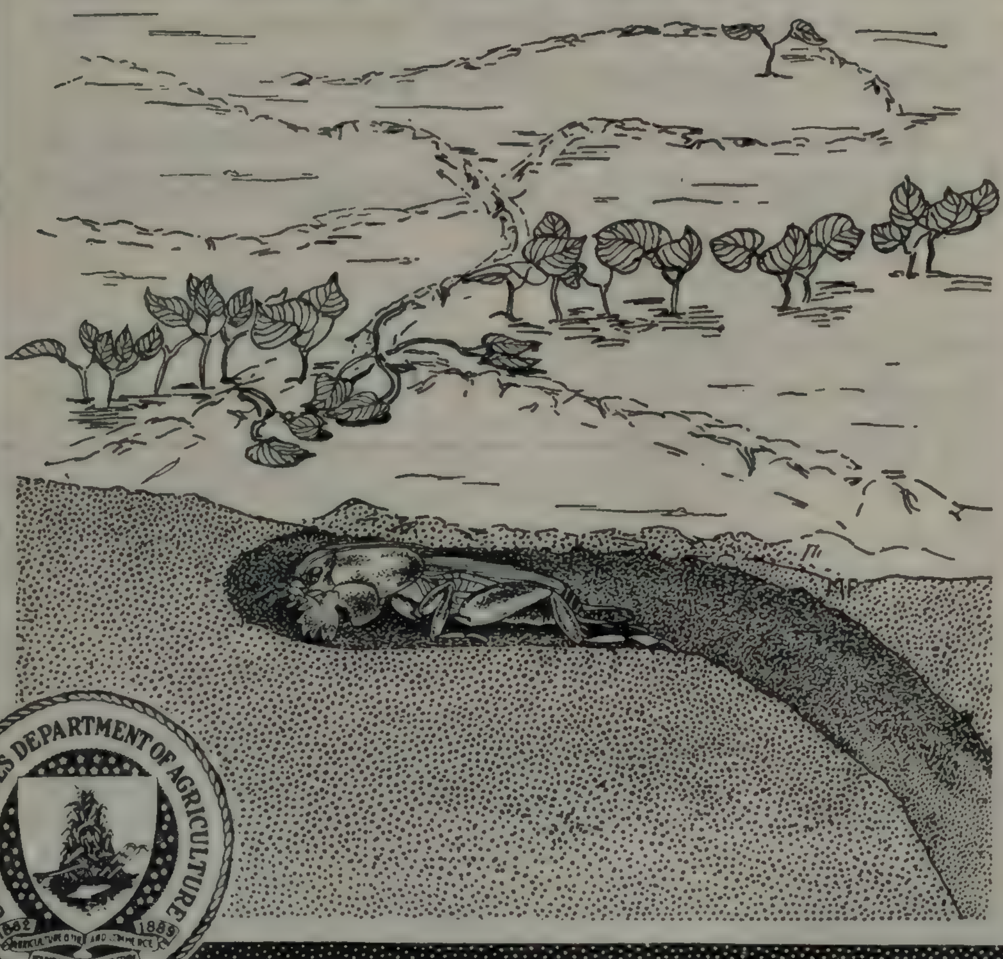
For safe carrying, crates must be loaded in the car compactly, with ample provision for the circulation of cold air, and they must be braced firmly to avoid shifting and damage in transit.

U. S. GOVERNMENT PRINTING OFFICE: 1928

Ind.

U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1561

The PORTO RICAN MOLE CRICKET



1862 1889

IN THE COASTAL AREA of Georgia, South Carolina, and North Carolina truck crops and some other cultivated growths are subject to injury by the Porto Rican mole cricket. This insect, a native of the West Indies and South America, seems to have been brought to the United States from Porto Rico early in the present century, and has spread and caused serious injury in the region named.

The insect, the nature of its depredations, and its control by means of a poisoned bait are described in this bulletin.

Washington, D. C. Issued April, 1928

THE PORTO RICAN MOLE CRICKET

By W. A. Thomas, *Assistant Entomologist, Division of Truck-Crop Insects, Bureau of Entomology*

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Quantity of bait per acre, and cost	7

MANY KINDS OF CROPS DAMAGED

TRUCK CROPS, especially in the seedling stage, in the coastal area from the southern border of Georgia to Wilmington, N. C., are subject to injury by the Porto Rican mole cricket,[1] known also in some sections as the changa or "ground puppy." Injury by the mole cricket, however, is not confined to truck crops; tobacco, peanuts, grasses, and chufas may also be damaged. Since the insect lives and thrives in moist, light soil, the lands devoted to truck crops in the infested area offer very favorable conditions for this pest.

DESCRIPTION OF THE MOLE CRICKET

Although the Porto Rican mole cricket belongs to the same family of insects as do the common hearth cricket and the field crickets, it does not to any great extent resemble other members of its family. The mature mole cricket ranges in length from 1¼ to 1½ inches, and is about one-fourth inch in width. In color it is light brown, the lower surface being much lighter than the upper, and slightly tinged with green. It is covered with fine hairs which give it a velvety appearance. The hind, or body, parts of the insect are soft, but the head and midsection bear a hard covering which protects it in its movement through the soil. The head carries a pair of threadlike antennae, or feelers.

The insect's most striking features are the rather large, beady eyes, and short, stout front legs, which bear shovellike feet well fitted for digging. The middle and hind legs are somewhat longer, especially the latter, and comparatively slender.

The mature crickets have two pairs of wings, which when at rest are folded along the back. The tips of the hind wings are curved downward, and reach just beyond the hind end of the body; the forewings are much shorter and rounded at the tips.

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[1] *Scapteriscus vicinus* Latr.; order Orthoptera, family Gryllidae, subfamily Gryllotalpinae.

The immature form is similar in appearance to the adult, except that it is smaller and wingless.

HOW THE MOLE CRICKET INJURES THE CROP

The greatest damage caused by the mole cricket to crops results from its burrowing in the upper inch or two of the soil. The burrows resemble those of a very small ground mole, the ground being pushed upward as the insect moves through it in much the same manner as it is pushed up by the mole. It is usually these ridges in the soil that give the first indication of the presence of the pest. The constant burrowing of the insect keeps the soil in the seed bed and about the plants in the field in such a disturbed condition that the sprouting seed and young plants can not develop properly. This burrowing is particularly destructive to seed beds, in which, because of it, many seeds fail to germinate and the seedlings die through the breaking of the delicate root system. Seedlings in the field are uprooted, and many dry out and die, as the burrows permit rapid evaporation of the surface moisture.

Injury resulting from the insect's feeding upon the crop is relatively small, although the mole cricket cuts off young plants and also feeds upon the seed, and these depredations cause considerable loss.

Aside from the injuries which result from its burrowing habit, the mole cricket cuts pits from one-eighth to one-fourth inch in diameter and varying in depth in the tubers of potatoes. In some cases this type of injury is severe enough to render the product unsalable. Sweet potatoes are subject to similar injury, although attacks on this crop are less frequent. In the early part of the season the seed of the peanut crop is fed upon, and in the fall the insect cuts openings in the shell of the mature nut and devours its contents. Chufa is injured in the fall by the insect, which feeds on the mature, fleshy root of the plant. Injury to this crop in the spring by the mole cricket has not as yet been observed. Seedling tobacco plants are damaged, both in the seed bed and in the field; in the former the mole cricket uproots and cuts off the seedlings. The mole cricket also injures the tobacco by girdling the stems of the plants shortly after they are transplanted to the field.

Among truck crops turnip, lettuce, spinach, kale, eggplant, tomato, beet, collard, cauliflower, and seedling onion suffer the greatest damage.

SEASONAL ACTIVITY OF THE MOLE CRICKET

The injury to the crop by the mole cricket usually first becomes noticeable in the latter part of March and continues until about the middle of June, the heaviest damage occurring during the latter part of April and early in May. At this time the overwintering forms are approaching maturity and seasonal conditions are favorable to their greatest activity. The first individuals of the new generation usually begin to appear in June and hatching continues until early in August. Seldom does any appreciable damage occur in the course of this period. The young forms are as active as the nearly mature ones, but because of their small size their work in the soil is not so noticeable. Surface conditions are also not so favorable to the young forms. The period of activity in late summer and fall, the most serious of the entire year, extends from August until late in October, the greatest activity occurring during the latter part of September. The late season is usually dry, and the surface burrowing which generally follows rains is particularly destructive to germinating seed and newly set plants.

WHERE THE MOLE CRICKET CAME FROM AND WHERE IT NOW OCCURS

The mole cricket is a native of the West Indies and South America, and there are indications that it was introduced into this country from Porto Rico in the ballast of ships from that island or possibly from others of the same group. As far as can be determined, the first reports of injury caused by it in the United States were received from the coastal section of Georgia a few years prior to 1909. Since that time the insect has spread, and it is now known to occur in the coastal section from below the southern boundary of Georgia to Wilmington, N. C., extending inland from the coast for a distance of about 100 miles.

At the present time the most serious injury occurs in the vicinity of Brunswick, Darien, Savannah, St. Marys, Folkston, and Beach, in Georgia; Beaufort, Charleston, Summerville, Kinstree, McClellanville, Georgetown, Myrtle Beach, Little River, and Wampee, in South Carolina; and Shallotte, Supply, Southport, and Wilmington, in North Carolina. The insect has also been reported from Jacksonville and Ortega, Fla. One report of its occurrence in Louisiana has been recorded.

The rate of spread is about 25 miles per year along the coast and slightly less toward the interior.

LIFE OF THE MOLE CRICKET

The insects of the group to which the mole cricket belongs do not have the four completely distinct stages of egg, larva, pupa, and adult, so characteristic of many insects. Instead, the mole cricket and all insects of its group are, when hatched from the egg, of the same general form as the adult parent, but wingless. As the insect grows it sheds its skin several times, and wings develop more or less gradually, until it becomes mature. After the egg, the mole cricket passes through eight such stages; the adult, in the last of these, lays the eggs from which the new series of stages will proceed. The first five immature, or nymphal, stages are wingless; in the sixth wing pads appear, and the adult has fully developed wings.

The mole cricket passes the winter in the ground, principally in an immature or nymphal stage. The immature, overwintering forms become active in March, and usually reach the adult stage some time in May or June. Soon after reaching maturity the females prepare an earthen cell at the end of a short burrow off from one of its main burrows, located from 1 inch to 4 inches below the surface. Small, greenish, oval-shaped eggs about one-eighth inch long by one-sixteenth inch in diameter are laid in these cells, generally from 40 to 50 eggs being placed in each. (Fig. 1.) The eggs hatch in about three weeks, and hatching continues until early in August.

For the first few days of their life the young are very sluggish and remain in the egg chamber, or earthen cell. After leaving the egg chamber they become very active and burrow in every direction in search of food. During their early stages the rate of growth is very rapid, but it slows up as the insects approach maturity. When the mole cricket has become about two-thirds grown it acquires wing pads, and from six to eight months after hatching from the egg it becomes mature and has fully developed wings.

The mature forms of the insect are found in greatest numbers in May, June, and July, although a few may be seen from late in October on through the winter. In Figures 2 and 3 the mole cricket is shown in several of its eight developmental stages.

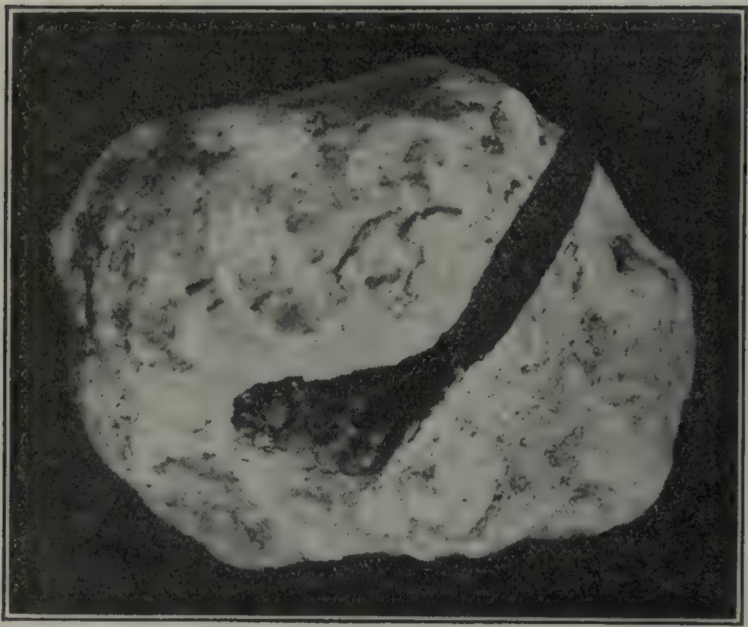

FIG. 1.—Lump of soil with cavity containing eggs of the mole cricket. The eggs are laid in the cavity which the female cricket makes at the end of a burrow. Enlarged about 1¼ diameters

HABITS OF THE MOLE CRICKET

Mole crickets live in burrows in the ground in much the same way as does the common ground mole. They thrive best in light, moist soils, which are easy for them to burrow through. The more compact, heavy clay soils are difficult for the insects to tunnel in, with the result that they are seldom found destructive in such land.

The depth at which they are to be found depends upon the soil moisture and temperature. When the soil is moist and warm, mole crickets burrow just beneath the surface. With a drop in temperature, or the drying of the surface soil, they move downward to a more suitable level. As the season advances and the surface soil becomes dry and hot they may go down to considerable depths in order to find favorable surroundings. During dry periods they may be found, however, working in the loose, moist soil in the bottom of field ditches or along roadways. The winter season is spent below the frost line.

Mole crickets are very active little creatures, burrowing through the soil both day and night in search of food. They avoid bright light, and if exposed to it will seek cover either in the soil or under some near-by object, burrowing in with great rapidity. At night their burrows are often deserted, the insects going to the surface in search of food. They have frequently been observed, especially where the soil was very compact or wet, traveling freely over the surface. Very often, instead of leaving its burrow, a mole cricket will push its head and a part of its body through the soil; and after remaining in this position for a few seconds, as if viewing surface surroundings and not finding them to its liking, it will disappear and continue its burrowing. There is apparently no particular time at night when the insect is more active than at another, but it is usually found on the surface the first hour or so after dark.

Evidences of the work of mole crickets are much more apparent after rainfalls, followed by warm, cloudy weather, than at other times.

The normal food of the Porto Rican mole cricket consists largely of decaying vegetable matter and a small quantity of animal matter. This pest frequents compost piles, where it often congregates in very large numbers. Fresh horse droppings strongly attract mole crickets. Remnants of crops, such as cabbage, lettuce, turnip, cantaloupe, and watermelon, partly covered by the soil after plowing, are favorite sources of food.

The mole cricket spreads chiefly by flight. Females have often been observed several miles in advance of normally infested areas. During migration the insect follows the ditches along highways and watercourses, where loose, moist earth is to be found. In newly infested areas the insect is first noticed about watering places on the farm, where the overflow from wells and watering troughs keeps the soil sufficiently moist to provide attractive locations.

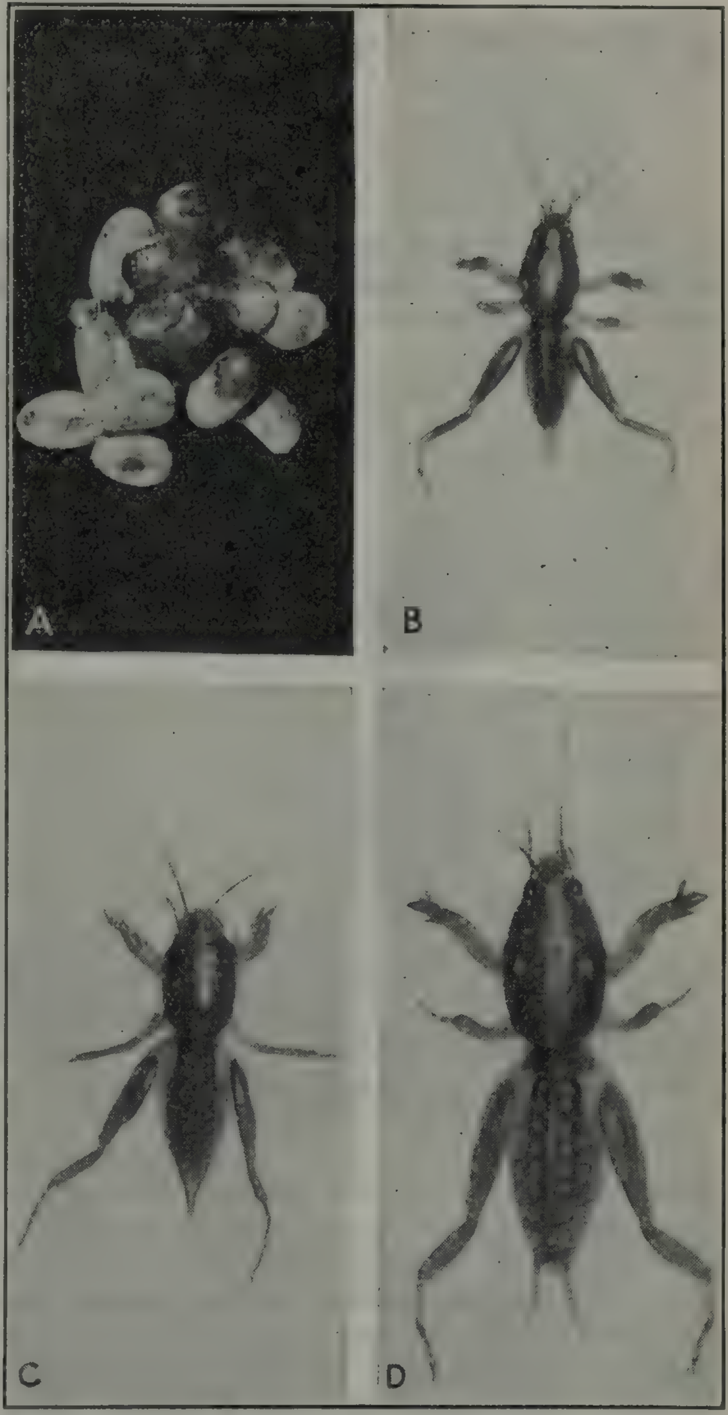

FIG. 2.—Stages of growth of the mole cricket: A, eggs; B, mole cricket about 4, and C, about 10, days old; D, immature form about 4 weeks old. Enlarged about 3 diameters

KEEPING DOWN MOLE CRICKETS WITH POISONED BAIT

Since mole crickets feed above ground at night, they can be controlled by using a poisoned bait.

THE BAIT AND HOW TO MIX IT

The formula for the bait is as follows:

Cottonseed meal	pounds	100
Rice flour	do	100
Calcium arsenate [2]	do	10
Molasses	gallons	1
Water	do	9

Thoroughly mix the cottonseed meal, rice flour, and calcium arsenate. Even and thorough distribution is very important, as for the success of the bait it is necessary that each particle of the meal and flour carry some of the poison. To the dry mixture add the mixed molasses and water, a small quantity at a time, so as to form a crumbly mash. Avoid adding too much water.

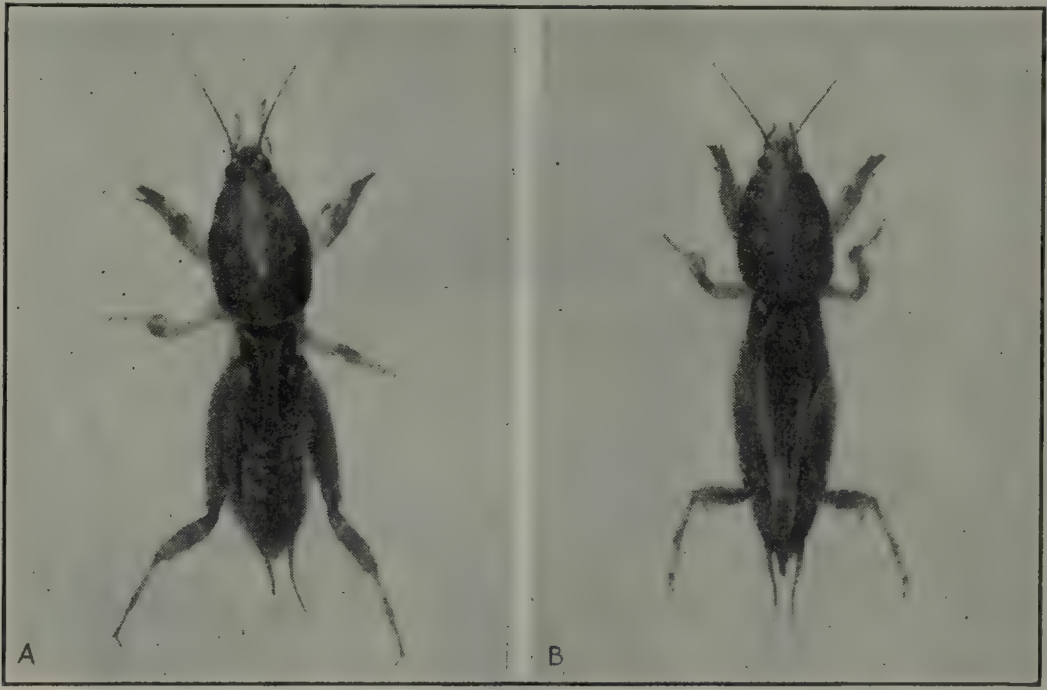

FIG. 3.—Last two stages of the mole cricket: A, last nymphal stage, with wing pads; B, adult mole cricket, with fully developed wings. Enlarged about 1¼ diameters

A very good procedure for preparing the bait consists in first mixing the cottonseed meal and rice flour together on a smooth, clean floor, or smooth, hard area of the ground. Then spread the material to an average depth of about 3 inches. Next, scatter one-third of the calcium arsenate as evenly as possible over the mixture of cottonseed meal and rice flour. Then begin at one edge, with a potato fork or hoe, and gradually work the material back toward the operator, making short strokes, until the whole pile has been stirred. Next draw the material from all edges toward the center to form a pile.

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[2] Paris green or white arsenic can be substituted for calcium arsenate, but since calcium arsenate is readily available in the affected region it is recommended here as a poison for the bait.

Spread the material again to a depth of about 3 inches and apply another third of the calcium arsenate to the surface, and repeat this process until the required quantity of calcium arsenate has been added. Add only a small quantity of the molasses solution at a time, and work this in thoroughly, adding more as needed, just as is done in mixing mortar or concrete for building purposes.

When only a small quantity of the poisoned bait is needed, for treating a small seed bed or similar area, the following formula may be used:

Cottonseed meal	pounds	5
Rice flour	do	5
Calcium arsenate	do	½
Molasses solution, 1 to 10	quarts	2

This quantity may be mixed with the hand in a large pail or a half-bushel tub. Do not use the hands for mixing the poisoned bait if there are abrasions on them, as poisoning may result. In such a case a small paddle may be used in the mixing. To avoid fermentation, which renders the bait ineffective, the mixture should be used within 48 hours after it is prepared.

HOW AND WHERE TO USE THE BAIT

A convenient method of applying the poison bait is to scatter it by hand from a bucket of about 3-gallon capacity. In treating unplanted areas, the bait should be sown broadcast, the first treatment being made about 10 days before planting and another immediately after planting. In cases where the crop has been planted in rows the bait should be applied by scattering it lightly between alternate rows, since the surface moisture usually found between the rows is more favorable to the mole crickets than is newly planted ground.

When necessary to treat the growing crop, scatter the bait lightly between the rows of plants. Repeat the application every week or 10 days until the presence of the mole cricket is not noticeable.

To treat a seed bed, scatter the bait lightly over the entire bed, and repeat the treatment immediately after seeding.

For treatment of grasslands or lawns, scatter the bait lightly over the area. Repeat every week or 10 days until all signs of mole crickets disappear. In case of a small area, reinfestation often takes place from adjacent untreated ground in the course of from four to six weeks; to prevent this occurrence the lawn should be treated with the poisoned bait once every month or six weeks during the warmer months of the year.

Ordinarily two applications are sufficient to control the mole crickets on any one vegetable crop. It is sometimes necessary, however, to make three or more applications in order to get complete control. If a heavy rain immediately follows an application, another application should be made as soon as possible thereafter.

QUANTITY OF BAIT PER ACRE, AND COST

Under ordinary conditions, 150 pounds of the dry material (weight before moistening) is sufficient to cover 1 acre, either broadcast or in rows 5 feet apart. If the crop to be treated is in rows, the application should be made directly to them, the same quantity of material being used per acre. At this rate of application about one-fourth of a pound is sufficient for 100 square feet, or 100 linear feet of row.

The cost of controlling the mole cricket will vary, and will depend largely upon the cost of labor. Ordinarily two applications will be sufficient. Including the expense of material and of the labor of mixing and applying, one treatment will cost from $2 to $4 per acre.

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U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1562

FARM PRACTICES UNDER CORN-BORER CONDITIONS

1862 1889

TO CONTROL the European corn borer and prevent serious damage to the corn crop, such as has been general in Ontario, and has occurred in limited localities in Ohio and Michigan, substantial changes in farm practices are often necessary. Under some conditions farmers in the infested areas may find it profitable to increase their acreages of crops other than corn.

This bulletin discusses the character of the problem in different parts of the infested area; indicates the control practices best adapted to different conditions; and points out the factors farmers should consider in deciding whether to reduce their corn acreage.

The methods of control discussed were all used to some extent in 1927. Those which have been found most satisfactory are described in detail in Farmers' Bulletin 1548, The European Corn Borer: Its Present Status and Methods of Control.

During 1927, information was obtained by the Bureau of Agricultural Economics, in cooperation with Ohio State University and the experiment station and extension service of Michigan, from 750 farmers in the infested areas of Ohio and Michigan on the labor and power required by different methods of control, their adaptability to particular conditions, and the influence of the borer upon the place of corn in systems of farming. This information forms the basis for many of the statements in this bulletin.

Washington, D. C. **Issued January, 1928**

FARM PRACTICES UNDER CORN-BORER CONDITIONS

By Jesse W. Tapp, *Agricultural Economist*, and George W. Collier, *Assistant Agricultural Economist, Division of Farm Management and Costs, Bureau of Agricultural Economics*, and C. R. Arnold, *Farm Management Demonstrator, Ohio State University*

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THE EUROPEAN CORN BORER has become well established at the edge of the Corn Belt, in northern Ohio, northeastern Indiana, and eastern Michigan. In a limited number of fields in Ohio and Michigan the borer was responsible for some commercial damage to the 1926 and 1927 corn crops. In the adjoining counties in the Province of Ontario the data of the Ontario Department of Agriculture show that the acreage of corn was reduced about 71 per cent from 1923 to 1927 on account of corn-borer damage. In 1927 slight infestations were found in eastern Corn-Belt areas considerably south and west of the 1926 infested area. (Fig. 1.) A joint committee of the American Association of Economic Entomologists, the American Society of Agronomy, and the American Society of Agricultural Engineers has expressed the opinion that "it will be impossible to eradicate the borer or even to prevent its spread to corn-growing areas not yet infested."

The continued spread of the borer in all directions, the increased infestation in most areas, and the great damage to the corn crop in Ontario all indicate that it is absolutely necessary for farmers in the infested areas to adopt farming practices which will be effective in keeping the infestation down to a minimum. The control practices which are necessary to keep the borer in check involve substantial changes in the usual methods of handling corn on Corn-Belt farms, particularly with respect to the disposal of cornstalks, stubble, or other refuse in cornfields, and the preparation of cornland for subsequent crops. These practices, for the time being at least, involve the use of additional labor and power.

In the spring of 1927, the labor used in preparing 1926 corn land for the 1927 crop in most of the corn-borer clean-up area was approximately twice the amount normally used. This was due partly to the farmers' lack of experience in performing the necessary control operations. Weather conditions were also generally unfavorable to the adoption of control practices in 1927, and under more favorable weather conditions, the control practices would not require so large an increase in the labor and power used in preparing cornland for the following crop. Nevertheless, even with more favorable weather conditions, the extra labor involved in control practices in most of the important corn-growing areas indicates the serious nature of the new farm-management problems which farmers in the infested areas are encountering.

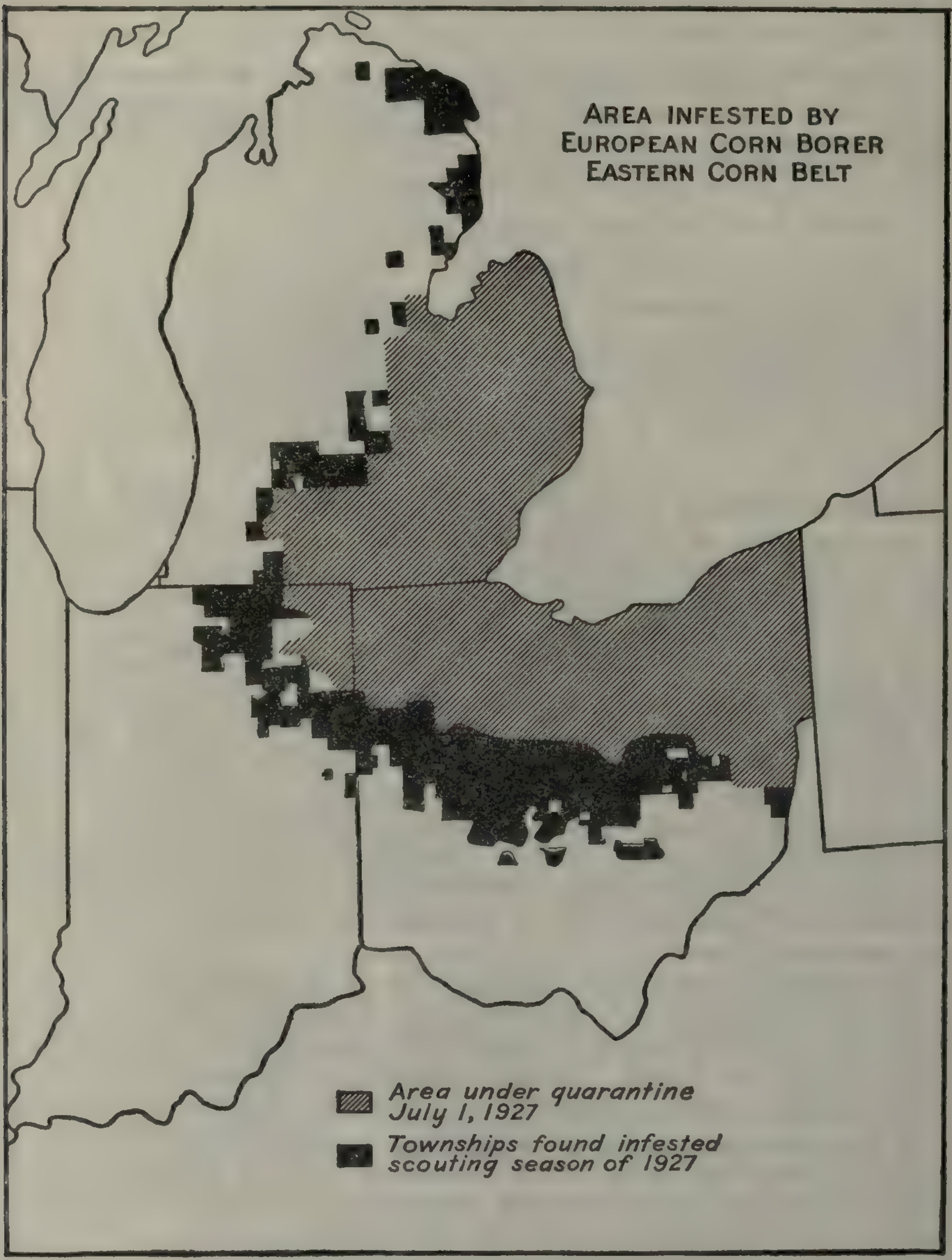
AREA INFESTED BY
EUROPEAN CORN BORER
EASTERN CORN BELT
▨ Area under quarantine July 1, 1927
■ Townships found infested scouting season of 1927

FIG. 1.—Areas infested by the European corn borer in the eastern Corn Belt. Some of the townships found infested in 1927 might have been infested previously as all of them were not scouted in 1926. The borer is spreading rather rapidly, however, to the West and South. Commercial damage in this portion of the United States has been limited to a few areas near the Great Lakes in northern Ohio and eastern Michigan

These new farm-management problems include questions as to (1) the most practical and economical methods of controlling the borer which can be fitted in with present systems of farming and (2) as to the desirability of making changes in present systems of crop and livestock production on account of the new conditions under which corn must be grown. This bulletin summarizes the available information bearing upon these problems, with a view to aiding farmers in the areas now infested, and in areas likely to be infested soon, in determining the adjustments which they should make in farm practices and farming systems.

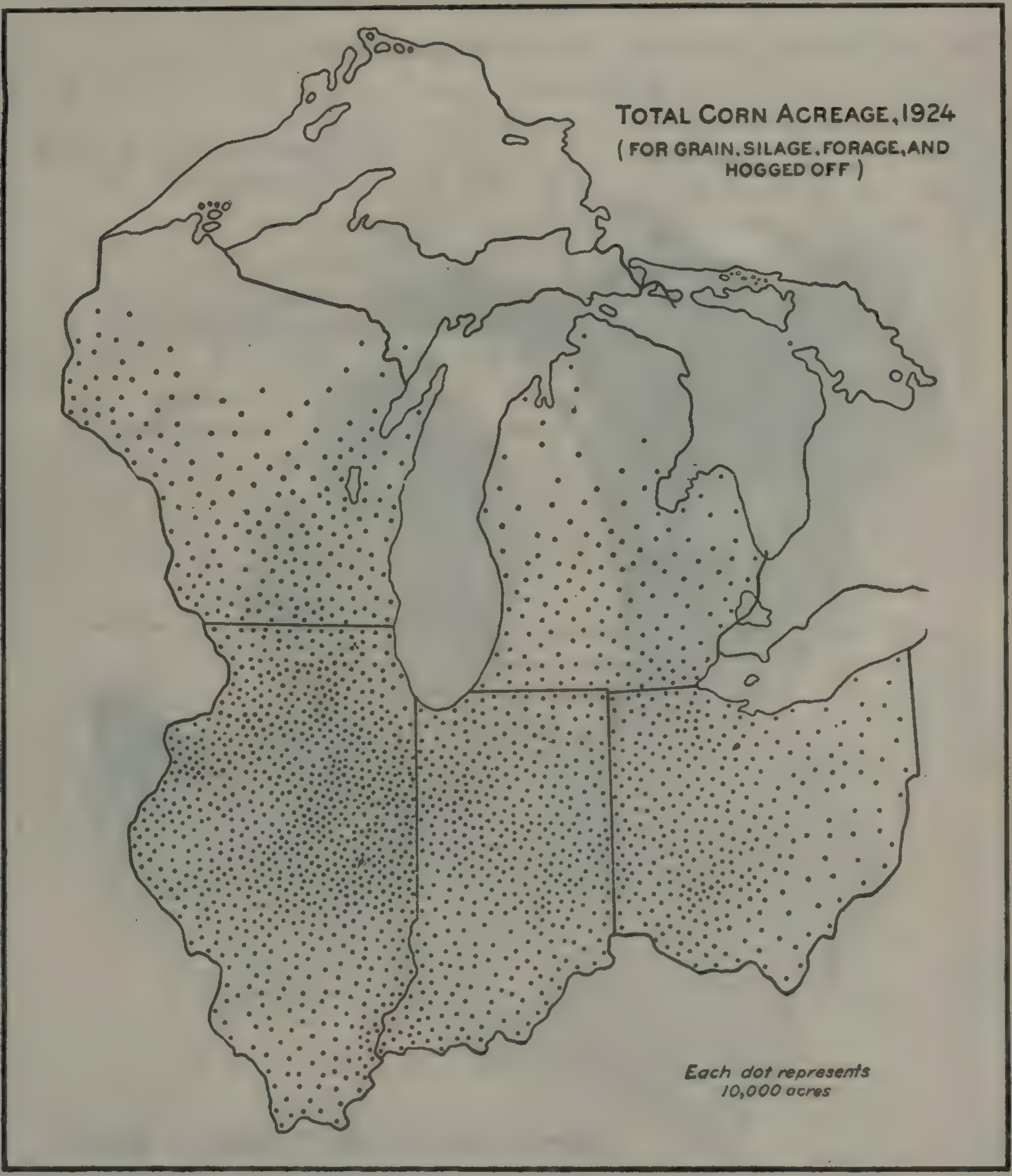
TOTAL CORN ACREAGE, 1924
(FOR GRAIN, SILAGE, FORAGE, AND HOGGED OFF)
Each dot represents 10,000 acres

FIG. 2.—Corn acreage in the eastern Corn Belt, 1924, based on Census data. The corn borer is just beginning to reach the areas of heavy corn production in the eastern Corn Belt

CHARACTER OF THE PROBLEM IN DIFFERENT AREAS

On most farms in the areas already infested, corn is the most important cultivated crop in the rotation, and is a primary source of feed for the livestock enterprises. Moreover, the borer is only beginning to reach the areas of heavy corn production. (Fig. 2.) The problems of adjusting farming practices to corn-borer conditions obviously will be more serious as the infestation spreads and increases to the west and southwest.

Where the acreage of corn per farm is relatively small, or where a large portion of the corn is put into the silo or shredded, the problem of controlling the borer is greatly simplified. In the infested area in northeastern Ohio the acreages of corn on most farms are relatively small. In this area, in 1924, about 14 per cent of the farms had no corn, over 50 per cent had from 1 to 10 acres per farm, and only 6 per cent of the farms had more than 20 acres. In north-central Ohio about one-third of the farms had from 11 to 20 acres of corn, in 1924, and half of the farms had over 20 acres. In the cash-grain area in northwestern Ohio and northeastern Indiana, however, over three-fourths of the farms had more than 20 acres of corn in 1924, and almost half of them had over 40 acres of corn per farm. From 11 to 20 acres of corn are most common on the farms in the north-

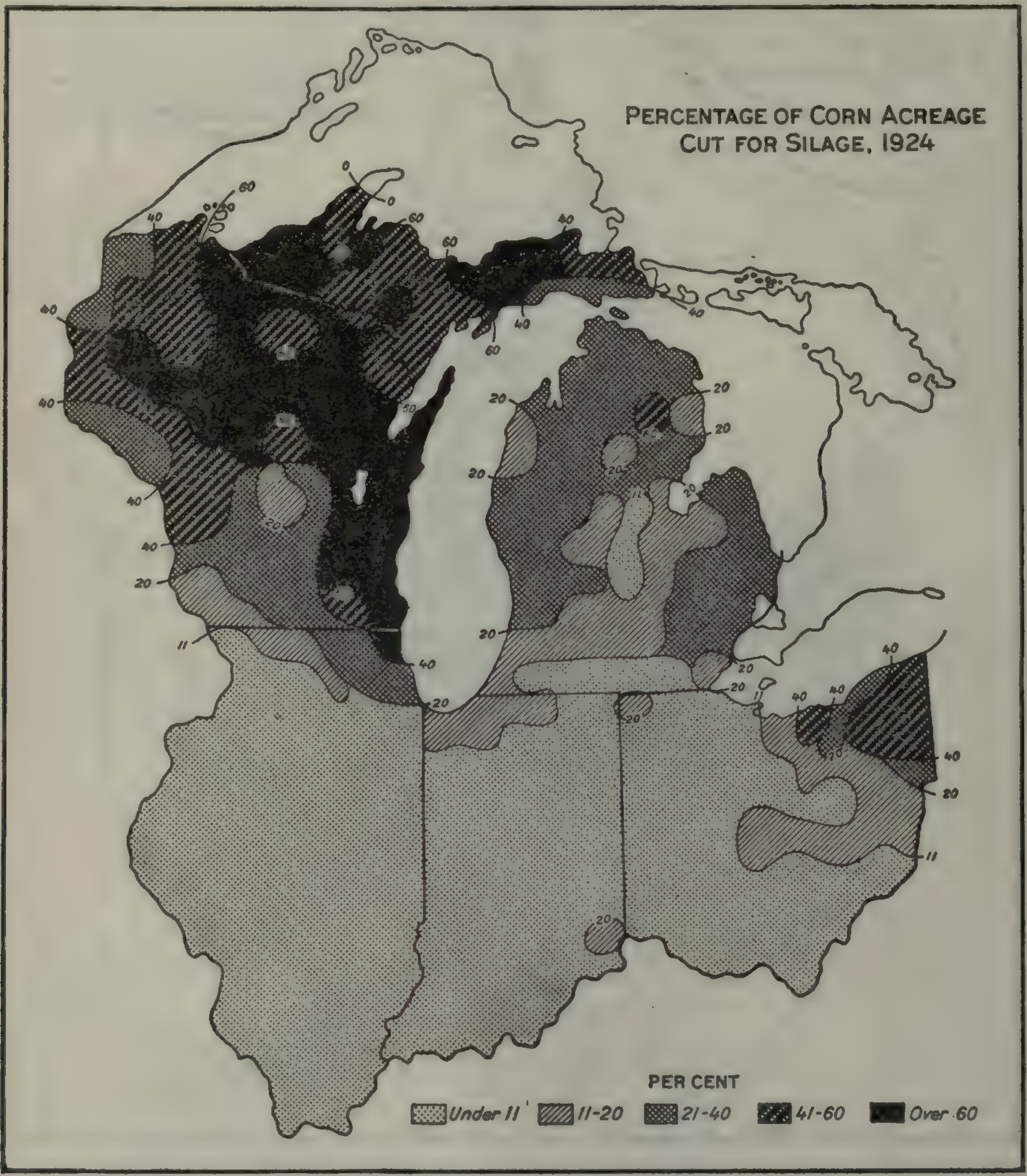

FIG. 3.—Proportion of corn put into silo in the eastern Corn Belt, 1924. Where a large part of the corn is put into the silo the problem of controlling the corn borer is greatly simplified

western corner of Ohio and in the southeastern corner of Michigan. In the northernmost portion of the 1926 infested area the corn acreages are similar to those in northeastern Ohio. In this area in 1924, about 10 per cent of the farms had no corn; 61 per cent had from 1 to 6 acres; only 29 per cent had more than 10 acres and less than 7 per cent had over 20 acres of corn per farm.

METHODS OF HARVESTING CORN

The problem of controlling the corn borer is closely related to the methods used in harvesting corn. In much of the area infested at present, a large proportion of the corn is cut and then is put into the silo, or is shredded, or is husked from the shock and the stover fed to livestock. (Table 1.) In the northeastern and north-central Ohio and east-central Michigan sections, from 80 to 95 per cent of the corn is cut. In the northwestern Ohio-southeastern Michigan section, on the other hand, only about one-third to one-half of the corn is cut, and in the cash-grain section of northwestern Ohio and northeastern Indiana less than 5 per cent of the corn is cut.

In those areas in which a large proportion of the corn is cut, the clean-up problem may be simplified by cutting the corn very near the surface of the ground, as recommended in Farmers' Bulletin 1548. If corn binders are used, difficulties are often met in attempting to cut and remove all stalks. This matter is not so important under ordinary conditions but is very important from the standpoint of corn-borer control.

When the corn goes into the silo practically all of the borers are destroyed, provided the corn is cut very low and all the stalks are removed from the field. In the northeastern Ohio portion of the present infested area, from one-fourth to one-half of the corn is put into the silo. (Fig. 3.) This greatly reduces the clean-up problem in that part of the infested area.

TABLE 1.—*Proportion of corn cut and put into silo or shredded, in selected areas in 1926 corn-borer territory*

Area	Percentage cut	Percentage put into silo or shredded
Northeastern Ohio	90 to 95	40 to 60
North-central Ohio	60 to 90	45 to 60
Northwestern Ohio and northeastern Indiana (cash-grain area)	0 to 5	0 to 5
Northwestern Ohio and southeastern Michigan	35 to 50	15 to 30
East-central Michigan	95 to 100	60 to 70

A rather large proportion of the corn in eastern Michigan is put into the silo, but only a very small part of the corn in the remainder of the infested area now goes into the silo. South and west of the present infested areas an even smaller portion of the corn is utilized in that way.

The use of the husker-shredder is a common practice on some farms in parts of the corn-borer area, particularly in northeastern and north-central Ohio and in eastern Michigan. This practice, under proper conditions, serves to destroy the corn borers in stalks, but in the more important corn-producing areas only a small part of the acreage is handled in this way. In the cash-grain area of northwestern Ohio and northeastern Indiana, for example, only a negligible proportion of the corn is either shredded or put into the silo.

Another harvesting practice is that of hogging down corn. This practice is not so common in the present infested area but is more common in the areas just at the edge of the present infestation. The areas east of the Mississippi River, where this practice is most common, are indicated in Figure 4. This method of harvesting corn may increase the difficulty of later clean-up. The stalks are broken down in every direction, and it is more difficult either to break or cut all of them loose for raking and burning, or to plow them under.

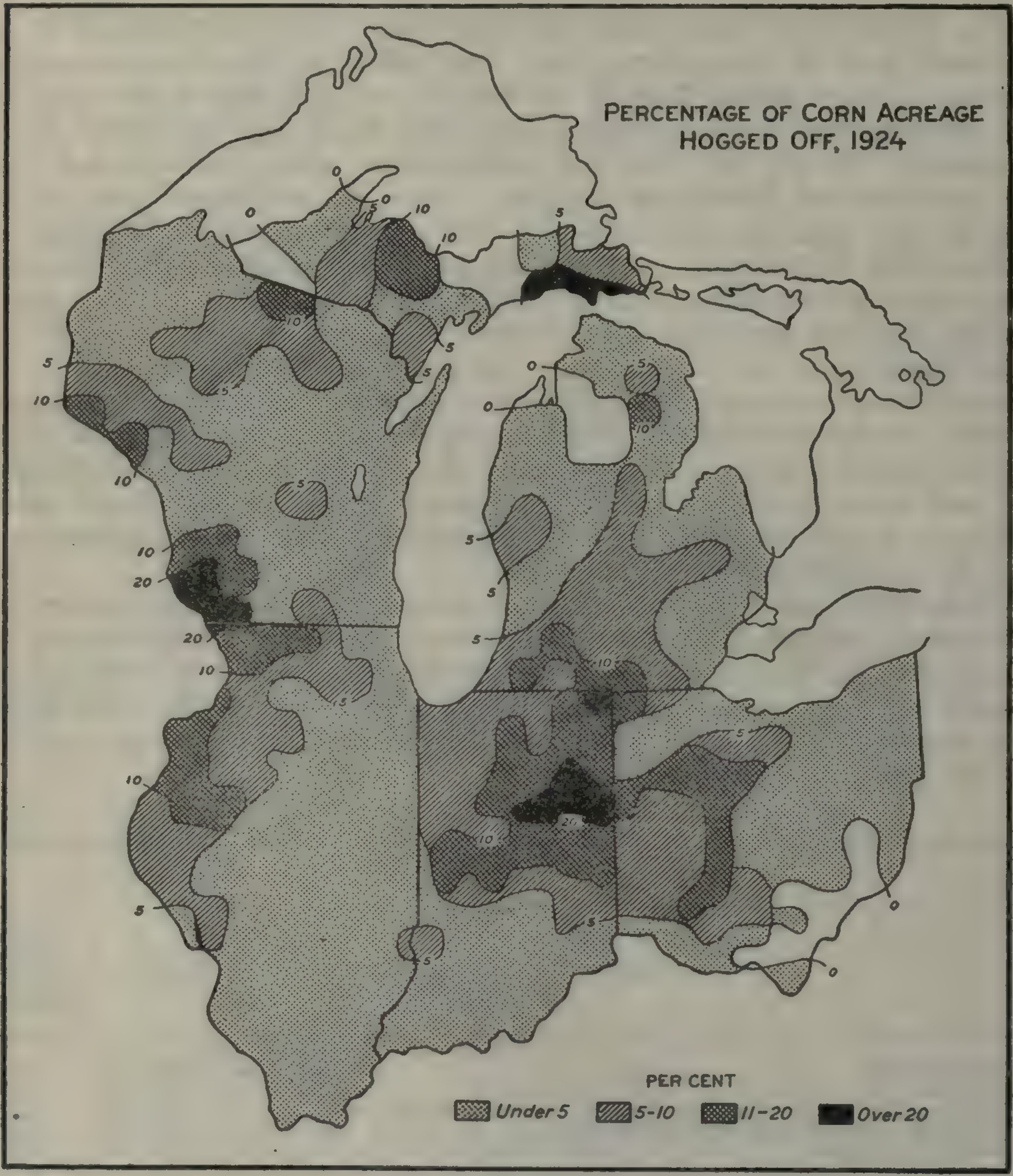

FIG. 4.—Proportion of corn harvested by hogging down, 1924. The extra work necessary for cleaning up cornstalks where the corn has been harvested by hogging down may make it necessary to abandon this practice

USUAL METHODS OF PREPARING CORNLAND

The usual methods of preparing cornland for subsequent crops are not satisfactory, in most cases, from the standpoint of corn-borer control. In order to keep the infestation down so that little or no commercial damage will result, it is necessary to destroy or to plow under, completely, all stalks or stubble before the time of the emergence of the moths. Some of the present methods of preparing cornland for other crops more nearly meet this requirement, or can be adapted to meet it more easily than can others.

In areas in which cornland ordinarily is plowed for the following crop, a slight adjustment in this operation will often be all that is necessary. The most difficult problem is found in those areas where stalk or stubble ground ordinarily is disked for a small-grain crop, and especially where soil conditions are such as to make plowing after corn a difficult practice.

In the northeastern Ohio part of the infested area practically all of the corn is ordinarily cut and much of it is shredded or put into the silo. From 80 to 90 per cent of the corn ground ordinarily is plowed for the following crop. All of these practices, with minor modifications, can be made effective measures in keeping down the corn-borer infestation in this area.

In north-central Ohio the acreage of corn per farm is considerably larger than it is farther east, and the farming systems include fewer dairy cows and more hogs and other livestock. A smaller proportion of the corn ordinarily is cut, so that more stalk ground must be prepared for the following crops. Cornland is practically all seeded to small grain. Slightly less than one-half of it is seeded to wheat in the fall, and most of the remaining acreage is seeded to oats in the spring. The cornland seeded to wheat ordinarily is disked twice before seeding in the fall, but occasionally a field is seeded with only one disking ahead of the drill. This is practically all stubble ground with a very small portion normally seeded between the rows of standing corn. Most of the stalk ground and some of the stubble ground is seeded to oats the following spring, either with or without plowing.

Ordinarily about one-third of the cornland of this section is plowed for subsequent crops. On account of the peculiar soil type over a considerable portion of this area, however, more labor often is required to get the land into condition to seed after plowing than if no plowing is done. Yields also are often lower on plowed ground. Where plowing is done, ordinarily a double disking and two harrowings, or one harrowing and one rolling after disking, are necessary to prepare the seed bed. Where the spring grain is seeded without plowing the land ordinarily is double disked and is sometimes harrowed once. On some farms stalks and stubble are broken down during the winter. Raking and burning stalks, however, were not common practices in this area before 1927, unless the corn was to be followed by corn or another cultivated crop.

Farther west, and along the Ohio-Indiana State line, lies the area of the heaviest corn production of any part of the present infested territory. Paulding County, Ohio, is typical of this area. Here practically all of the corn is husked from standing stalks, and the land is seeded to oats the following spring. Very little livestock of any kind is kept. Ordinarily none of the corn ground that is seeded to oats is plowed. It is usually not practicable to get rid of the stalks by plowing them under, because of the difficulty in getting the land into condition and because the oat yield often is reduced on plowed land. The extra labor needed for plowing large acreages delays seeding, and such delay often causes a still further reduction in yields. Normally this land is disked once or twice and then seeded, although some is seeded with no previous preparation.

In the area which includes the northwestern corner of Ohio and the southeastern corner of Michigan approximately one-half of the cornland is plowed for the following crop, and the operations are similar to those in common use in the north-central part of Ohio. The nature of the soil makes plowing in the spring much more satisfactory than it is in the area farther south and west.

The situation in the northern part of the infested territory in east-central Michigan is similar to that in northeastern Ohio. From 75 to 90 per cent of the cornland normally is plowed for the following crop, practically all of the corn is cut, and a large part of it is put into the silo or is shredded. Hence only minor changes from present practices are needed.

LABOR AND POWER REQUIRED BY CONTROL PRACTICES

The means of controlling the corn borer, as outlined in Farmers' Bulletin 1548, include the following methods or combination of methods of disposing of infested plants:

(1) Feeding to livestock direct from the field, or as silage, or as finely cut or finely shredded material.
(2) Plowing under cleanly.
(3) Burning completely.

In selecting the most desirable method for particular circumstances, consideration must be given to the usual practices in harvesting corn and preparing cornland for another crop, the labor and equipment available, and the extra labor and additional investment involved in adopting various other methods. If plowing in the spring, following corn, is a customary practice, for example, the most practical method probably would be different from that in another section where the spring crop is usually seeded without plowing. Likewise where the corn is cut the most practical means of control is different from that where the corn is husked from the standing stalks.

HOW TO HANDLE STUBBLE GROUND

PLOWING UNDER STUBBLE

In northeastern Ohio and east-central Michigan, where most of the corn is cut, most of the stubble ground ordinarily is plowed for the next crop. In north-central Ohio, in the northwestern corner of Ohio, and in southeastern Michigan, a smaller proportion of the cornland is handled in this way. Where corn-stubble ground is plowed and the plowing is done satisfactorily, the labor required per acre for preparing the land for another crop, including the operations necessary to dispose of all stubble, would be about as follows:

	Man-hours	Horse-hours
Breaking stubble	0. 5	1. 0
Plowing	5. 0	15. 0
Disking (double)	2. 0	6. 0
Harrowing	. 8	2. 4
Rolling or dragging	. 8	1. 6
Total per acre	9. 1	26. 0

Where the plowing is done very carefully or where large plows or special attachments for covering stalks are used the stubble can be disposed of completely by these operations.

On farms where the cornland is handled in this way the only extra labor involved is that for breaking stubble before plowing, and even this operation will not be necessary if the corn is cut fairly low. If small plows are used, as on a large proportion of the farms in northeastern Ohio and east-central Michigan, it may be necessary to hand pick and burn the stubble left on the ground after the plowing and the seed-bed preparation are completed. The necessity for this work may be obviated, however, by cutting the corn as low as 2 inches. Either low cutting or more careful plowing can be substituted for most of the hand picking and burning of stubble that was done by farmers in these sections of the infested area in 1927.

The selection of the most desirable method of destroying the borer is a greater problem in areas and on farms where the stubble ground normally is disked in preparation for the following crop, instead of being plowed. Under these conditions the following labor per acre is ordinarily used in preparing the land:

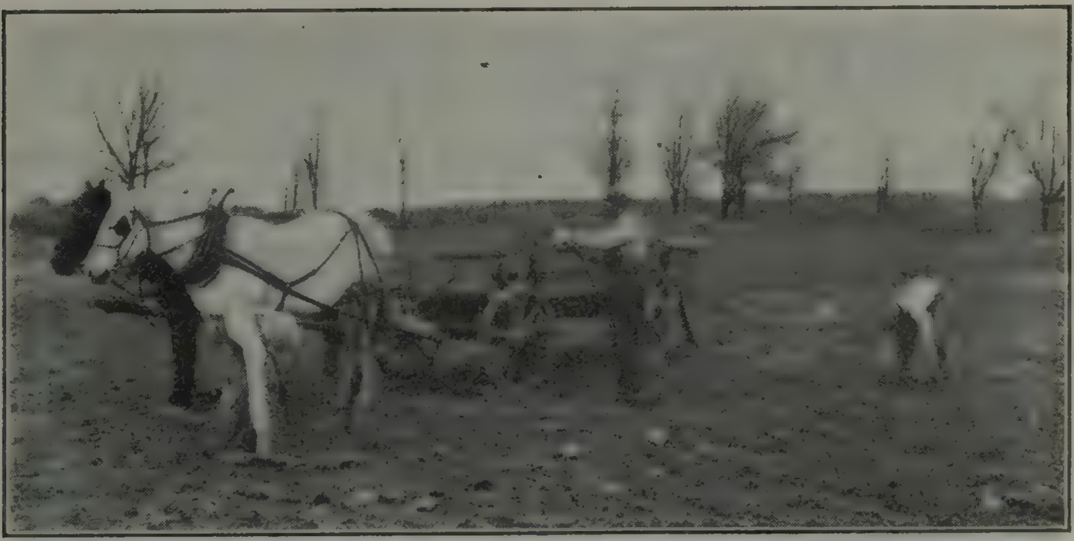

FIG. 5.—Picking up stalks, stubble, and other trash by hand is a tedious and back-breaking job. Work of this type can usually be avoided on stubble ground either by low cutting or plowing, and on stalk ground by plowing or breaking off, raking, and burning

	Man-hours	Horse-hours
Disking (double)	2.0	6.0
Harrowing or rolling	0.8	2.4
Total per acre	2.8	8.4

Several methods of modifying these practices so as to control the borer are practicable. The land can be plowed and handled in the same way as indicated above, where plowing is the customary practice. If the character of the soil is such that this can be done, this method would require a total of approximately 9.1 hours of man labor and 26 hours of horse work per acre. This amounts to about 6.3 hours of man labor and 17.6 hours of horse work per acre in addition to that required for disking and harrowing. The need for this extra labor is caused in part by the necessity for more seed-bed preparation after plowing than after disking.

BREAKING, RAKING, AND BURNING STUBBLE

One method of destroying stubble, used to some extent in 1927 on land that was not plowed, consisted of breaking, raking, hand picking, and burning the stubble and then preparing the land for seeding in the usual way. This method of handling stubble ground is not satisfactory, however, because of the difficulty of raking stubble, which makes it necessary to do much hand picking afterward. Either low cutting or plowing under are equally effective in disposing of the stubble, and they have the advantage of eliminating the back-breaking and tedious work of hand picking. (Fig. 5.)

LOW CUTTING

On some of the farms of north-central and northwestern Ohio and southeastern Michigan the character of the soil makes it impracticable to plow the cornland the following spring for a small-grain crop. The larger acreages of corn per farm also add to the difficulty of meeting the situation in this way. On farms that have 30 acres of corn (which is a common acreage on farms in this area), about 24 days of extra labor would be needed for doing the extra plowing. The most satisfactory way of reducing the extra labor on these farms is by cutting the corn as low as 2 inches, so that the land may be prepared for small grain without plowing or without a large amount of other later clean-up work. This method of handling the cornland on these farms will be more practical as a means of control than the performance of such a large amount of extra labor for plowing, or than attempting to dispose of the stubble by raking, hand picking, and burning.

USE OF STUBBLE BEATER

Still another method, where the land is not plowed, is the use of the stubble beater. The stubble beater does satisfactory work where all of the stalks are removed in cutting and the stubble is not over 10 inches in length. It is not satisfactory on unattached stubble, or on closely spaced rows, or on very rough or stony ground, or where weeds carry an important proportion of the borers. Results are more satisfactory if the beater is used in the fall than if used in the spring. On farms on which the corn acreage seems large enough to justify the investment in a stubble beater it will usually be more economical to buy a low-cutting attachment for the corn binder or a new low-cutting binder instead, and avoid the necessity for the extra operation.

HOW TO HANDLE STALK GROUND

If corn is husked or snapped from the standing stalk, clean-up operations include breaking or cutting off the stalks, raking and burning them; the use of special attachments for plows, such as wires or chains to aid in covering the stalks; and the gathering by hand of any material on top of the ground that might harbor corn borers. Careful plowing is probably even more important than where the corn has been cut. The most satisfactory means of getting rid of cornstalks is to do a good job of raking and burning. Special cornstalk rakes, with the teeth set close together and held rigidly, are more effective for this work than is the ordinary dump rake.

PLOWING STALK GROUND

Where stalk ground is ordinarily plowed for the following crop, the labor used per acre for preparing the land, including the operations necessary to control the borer, would be about as follows:

	Man-hours	Horse-hours
Breaking stalks	0. 5	1. 0
Raking stalks	. 7	1. 4
Burning stalks	1. 0	----
Plowing	5. 0	15. 0
Disking (double)	2. 0	6. 0
Harrowing	. 8	2. 4
Rolling	. 8	1. 6
Total per acre	10. 8	27. 4

In 1927 this method of preparing cornland for the next crop was common on farms in southeastern Michigan and in parts of north-central and northwestern Ohio. The only extra operations where the stalks are ordinarily broken off before plowing are raking and burning the stalks. The labor required for these extra operations amounts to about 1.7 hours of man labor and 1.4 hours of horse work per acre.

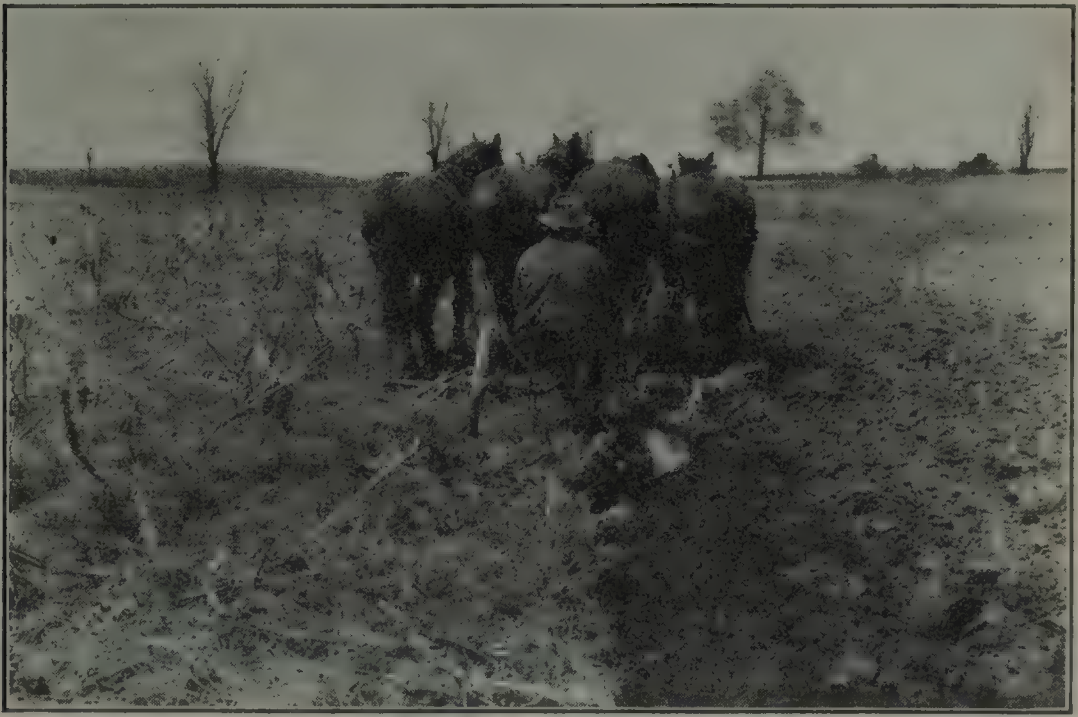

FIG. 6.—Stalks or stubble can be disposed of completely by careful plowing. Wires, chains, or other attachments aid in turning under all stalks and weeds

On some farms the cornstalks ordinarily are plowed under completely, without any raking and burning beforehand. (Fig. 6.) Under such circumstances only a small amount of extra labor is necessary in meeting corn-borer control requirements. The stalks are much more likely to cause trouble later, however, by being brought to the surface in harrowing or cultivating. Whenever possible, the culti-packer or roller should be used to a greater extent, and the harrow as little as possible, to avoid bringing to the surface the stalks which have been covered.

Where soil conditions are such that the plowing of stalk ground is the usual method of preparation for subsequent crops, the use of wide-bottom plows, together with somewhat deeper plowing, turns the stalks and trash into the bottom of the furrow more effectively, and if a chain or wires are used, practically all surface material will be covered. This is an important means of controlling the borer on open soils where the wide furrow slice can be easily worked down.

In much of the infested area—particularly the cash-grain area of northwestern Ohio and northeastern Indiana and parts of north-central Ohio and southeastern Michigan—the stalk ground ordinarily is disked for small grain. When handled in this way the time required for preparing the land under ordinary conditions is about the same as for disking stubble ground. Under these conditions more extra labor is involved in disposing of the stalks to destroy the borers. If the stalks are disposed of by breaking, raking, burning, and plowing under as outlined above, all of these operations must be performed in addition to the usual disking and harrowing. An extra harrowing or rolling may also be necessary to put the seed bed in good condition. Thus the extra labor for disposing of the stalks by this method, as contrasted with the situation where the land is usually seeded without plowing, would be about 8 man-hours and 19 horse-hours per acre.

Where wide-bottom plows can be used, some of the labor of breaking, raking, and burning stalks may be eliminated. If all of this were eliminated, however, the extra work would still amount to about 5.8 man-hours and 16.6 horse-hours per acre. On farms growing 30 to 40 acres of corn, which is common in this area, even this amount of extra labor per acre would involve from 20 to 30 days of extra man labor per farm. If the other extra operations are done in addition to the plowing, a total of from 35 to 45 days of extra man labor would be needed for cleaning up 30 to 40 acres of cornland.

BREAKING, RAKING, AND BURNING STALKS

Another method of disposing of the stalks, which was used rather extensively on stalk ground in the spring of 1927 consisted of breaking, raking, and burning the stalks, followed by the usual disking and harrowing. The labor used per acre for extra operations by this method would be about as follows:

	Man hours	Horse hours
Breaking stalks (twice over)	0. 8	1. 6
Raking stalks (twice over)	1. 4	2. 8
Burning stalks	2. 0	---
Total per acre	4. 2	4. 4

In addition to the extra labor for breaking, raking, and burning stalks, a great deal of labor was used on some farms in the spring of 1927 for handpicking the stalks or trash not completely gathered up by the rake. This method of disposing of stalks is very expensive, however, and every effort should be made to do the raking and burning so that hand picking will be unnecessary. (Fig. 7.) The stalks can be raked more effectively with special stalk rakes than with the ordinary dump rake. Where the special rakes are used the labor for hand picking may be avoided or greatly reduced.

At best, however, the disposal of the stalks by this method would require about 4.2 man-hours and 4.4 horse-hours per acre for breaking, raking, and burning stalks. The advantage in disposing of the stalks by this method is the fact that much of the work can be done during the late fall and winter so that the work of preparing the land and seeding spring grain may proceed about as usual. Losses through lower yields of spring grain, when seeded after plowing on certain types of soil, are also avoided. If the hand picking can be eliminated through the use of special stalk rakes the extra labor for cleaning up 30 or 40 acres of stalk ground by this method may be reduced to 15 to 20 days, most of which can ordinarily be done ahead of the rush season in the spring.

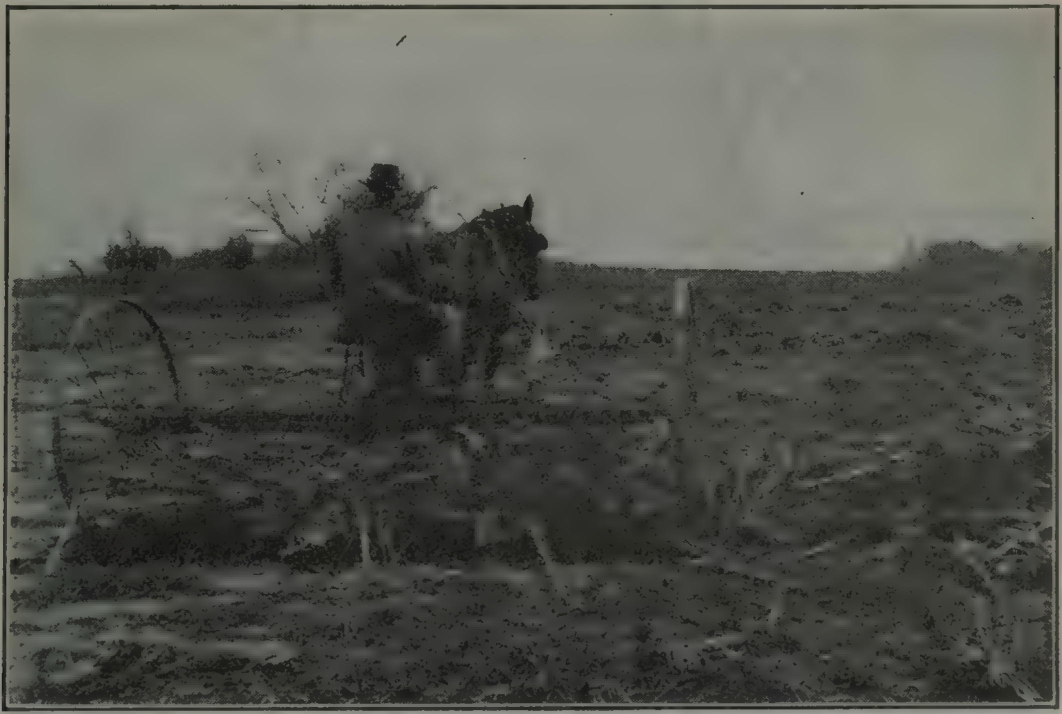

FIG. 7.—Raking and burning stalks must be done cleanly if the work is to be effective in controlling the borer. Where the land is not to be plowed afterward the stalks should be raked both ways. Special stalk rakes are much more satisfactory for this work than the ordinary rakes

HOW TO REDUCE BARN-LOT CLEAN-UP

If the corn is cut and the whole stalks fed, those parts of stalks which are not eaten must be disposed of as completely as are the stalks which are left in the field. The borers do not live over the winter in stalks which are buried deeply in manure. The common practice in some areas, of scattering cornstalks in the pasture for livestock, or of allowing them to accumulate in barnyards or feed lots, will have to be modified if the borer infestation is to be kept down. (Fig. 8.)

In parts of the infested area in northeastern Ohio the extra labor needed for removing and disposing of stalks around barnyards and in feed lots was greater in 1927 on some farms than that needed for disposing of stubble or stalks in the field. Much of this work can be avoided by modifying the method of feeding stalks to livestock. One of the most important ways of doing this is through the greater use of silage or shredded stover on farms where the acreage of corn and numbers of livestock are sufficient to justify the expense of shredding or the construction of a silo. (Fig. 9.) The amount of labor required for the use of the husker-shredder is about the same as for husking the corn from the shock. The use of the husker-shredder, when combined with low cutting, has the advantage of completely disposing of practically all of the borers, thereby avoiding the necessity for other more laborious means of control.

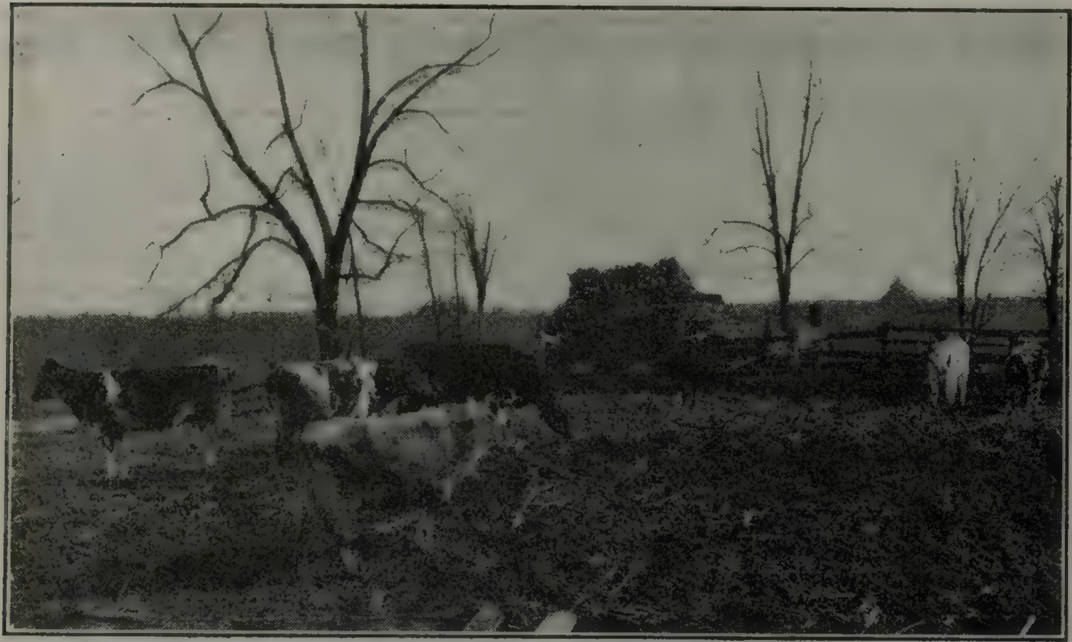

FIG. 8.—Stalks in feed lots or pastures must be disposed of just the same as those left in the field. The stalks should be fed in such a way as to avoid the necessity for clean-up work of this type

WHEN TO DO CONTROL WORK

The time of the year when corn-borer clean-up operations may be performed to best advantage is almost as important to farmers as is the amount of this work to be done. As much of this extra work as possible should be done before the rush of spring work begins.

The effort to reduce the amount of labor necessary during the spring should begin as early as September of the previous fall. If the corn for the silo is cut as low as 2 inches, all the borers that are in such corn are killed, either by the silage cutter or by the acids formed after filling the silo. It is probably even more important to cut the corn low in October because the borers work downward in the stalk late in the season.

If the stubble beater is to be used on land that is to be sown to wheat in the fall, it should be used in September or October, provided the stubble is not over 10 inches long and provided the other conditions for the use of this machine are satisfactory. The use of a low-cutting binder will usually be more satisfactory.

Besides plowing under as much corn-stubble ground as possible in the fall, it should be advantageous to plow part of the corn ground on which the corn has been harvested from the standing stalks. This can be done in seasons which are favorable for plowing, during the latter part of November and the first part of December, if the corn husking is out of the way. If the cornland that is to go into spring grains is harvested first, and is pastured while the rest of the corn harvest is being completed, it often is possible to get this much plowing done late in the fall if the season is favorable. This is especially important on soils that can not be plowed in the spring and worked down into a satisfactory seed bed in time to seed small grain.

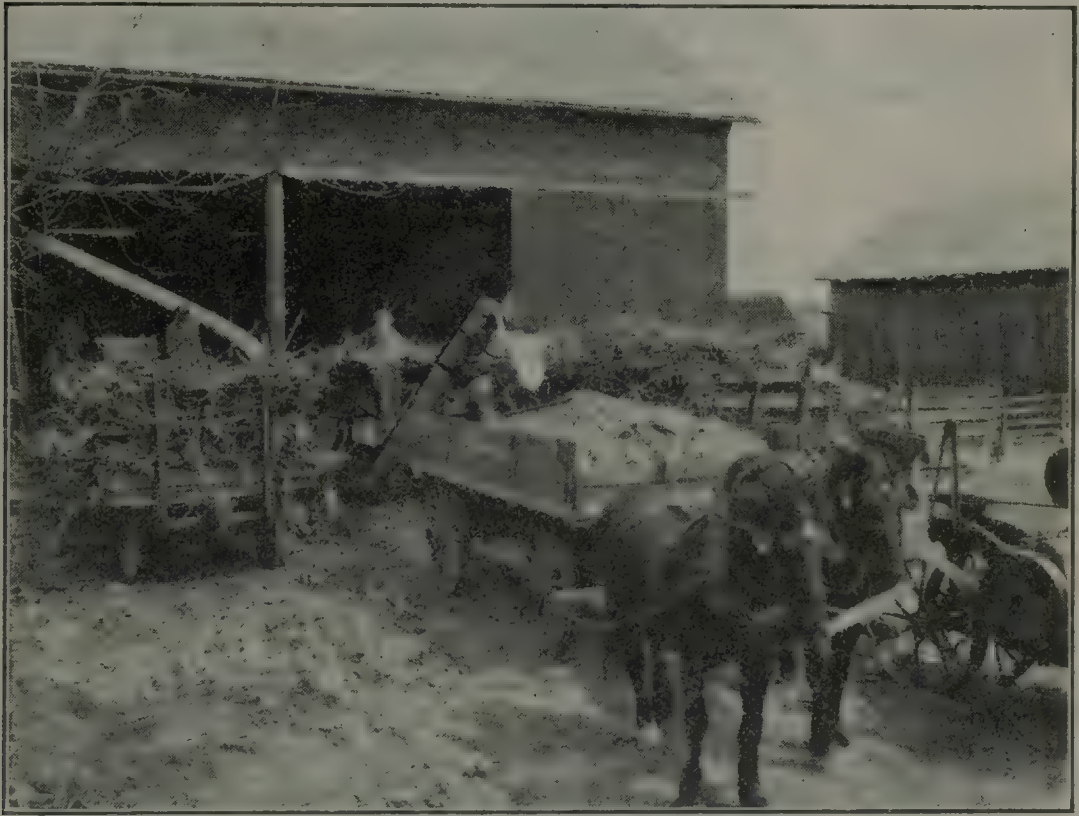

FIG. 9.—The use of the husker-shredder combined with low cutting is an effective means of destroying corn borers and eliminating the necessity for other control operations

In January or February the standing stalks may be broken off with a T rail or pole, if there is a period during that time when the ground is frozen and free of snow. If the stalks are frozen dry they may also be raked and burned at this time. This will reduce considerably the amount of clean-up work to be done later in the spring. Any bright, dry weather in winter should be utilized in destroying cobs and trash, especially cornstalks, around the barns and feed lots.

During the last of March, or early in April, the cornstalks that have not been destroyed during the winter should be raked and burned. Plowing for spring grain should be done early in the spring—in March if possible. If land is not to be plowed, a part of the hand picking may also be done at this time.

During April most of the disking, harrowing, seeding, and rolling is usually done. In cases in which the land is plowed it is more advantageous to do any unavoidable hand picking after the ground is seeded. During the last half of the month the cornstalks on land that is to be fitted for corn again may be broken or cut off, raked, and burned, if weather conditions during the winter have made it impracticable to do it before that time. The hand picking of stalks and trash on the surface, after seeding or planting, should be done when the weather is favorable for burning, and so far as possible it should be sandwiched in between other field operations during this month.

CONTROL-WORK CALENDAR

September	Cut corn low for silage.
October	Cut corn low for shredding or shock feeding.
November	Harvest standing corn.
	Plow corn-stubble ground, where practicable.
	Shred corn fodder.
December	Plow early harvested stalk ground if weather permits.
	Shed corn fodder.
January and February	Break standing stalks if no snow.
	Rake and burn stalks if frozen dry.
	Destroy cobs and trash around barns and feed lots.
March	Rake and burn stalks if not already done.
	Do early spring plowing.
April	Disk for small grain.
	Harrow.
	Seed small grain.
	Hand pick and burn after seeding if necessary.
	Rake and burn stalks on corn ground.
	Plow for corn.
	Disk corn ground.
	Destroy cobs and trash around barns and feed lots.
May	Harrow corn ground.
	Roll corn ground.
	Plant corn.
	Hand pick stalks and trash after planting if necessary.

CHANGES IN CROPPING SYSTEMS

The actual damage to the corn crop in the eastern Corn Belt of the United States has been limited to such small acreages that no pronounced shift from corn to other crops has occurred. In the Canadian areas where the infestation and damage have been heavy there has been a marked shift from corn to such crops as oats, barley, wheat, peas, beans, hay, sugar beets, and tobacco. In some localities over half the corn has been displaced by these crops.

Many farmers in the infested areas of Ohio and Michigan, and in adjacent areas, are faced with the question as to whether the necessity for adopting control practices and the possibility of reduction in the yield of corn may make it desirable for them to replace a part of the corn acreage with other crops.

The answer to this question depends mainly on two things: (1) The advantage of corn over other crops either as a feed crop or as a crop for sale, and (2) the ease or difficulty with which methods of corn production may be modified so as to keep down the borer infestation and avoid serious commercial damage.

The general adoption of practicable methods of control such as have been outlined in the preceding pages should prevent serious damage to the corn crop and obviate the necessity for any general replacement of corn with other crops.

Such changes as were made in crops grown in the infested areas of Ohio and Michigan in 1927 were due almost entirely to the increased amount of labor and power needed in growing corn under corn-borer control regulations then in force and to fear of future borer damage, rather than to actual damage by the borer. Another factor of importance, in some areas, was the prospective reduction in yields of oats or other crops, following corn, on account of changes in methods of preparing cornland for the next crop. This was especially important in localities in which the soil is very difficult to handle when cornland is plowed in the spring for a small-grain crop.

In northeastern Ohio and east-central Michigan the adoption of control practices requires only minor adaptation of the present practices on most farms. If these practices prove to be effective in keeping the infestation below the point of important commercial damage, farmers no doubt will find it more advantageous to follow these practices than to turn to other crops which produce less revenue or less feed per acre than does corn. This is especially true on those farms where the corn is put into the silo or is shredded.

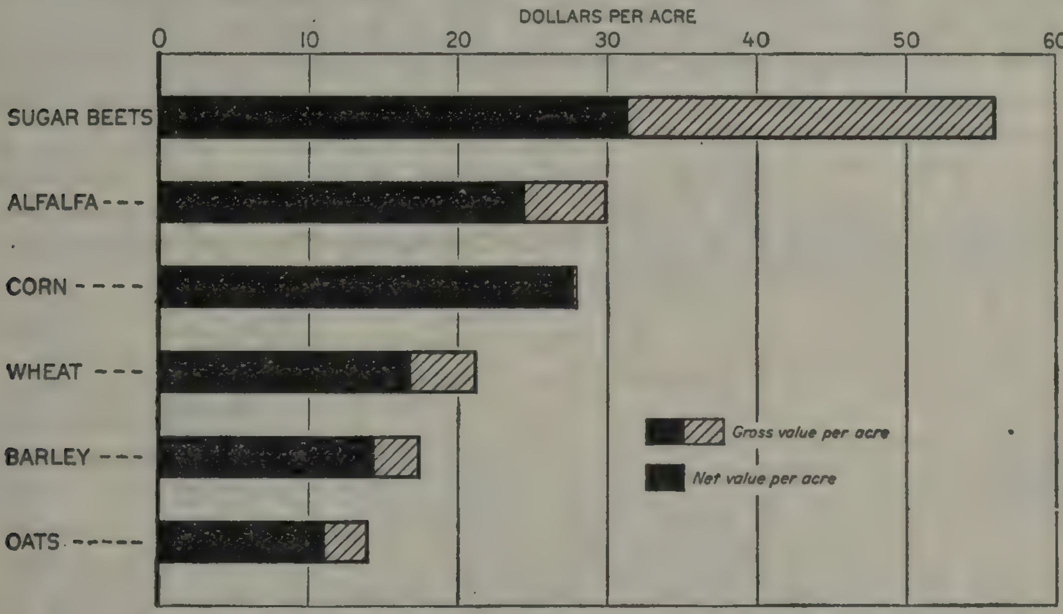

FIG. 10.—Average gross and net values per acre of corn and alternative crops, northwestern Ohio and southeastern Michigan. (The net value is the gross value after deducting cash costs.) The small-grain crops—wheat, oats, and barley—do not compare favorably with corn from the standpoint of value per acre

The farmers in other sections of the infested area are more interested in a possible shift of a part of the corn acreage to other crops. The larger acreages of corn per farm, the necessity for new operations involving additional labor and power for corn production, the fact that only a part of the cornstalks are now used for feed, and the difficulties encountered in some localities in plowing cornland in the spring for a small-grain crop, all combine to make this problem more important in those sections.

The crops most commonly grown in the area are naturally the ones to which farmers would give attention when considering possible changes in their farming systems. Oats, wheat, and mixed clover and timothy hay are the only crops which now occupy an acreage comparable with corn in the present infested area. If the borer infestation should increase to the point of causing serious commercial damage, these crops would no doubt be the first to be considered by most farmers as possible substitutes.

Sugar beets are grown to some extent in the northwestern Ohio and southeastern Michigan area and are a possible substitute crop, especially in localities where corn is grown primarily for sale rather than as a feed crop. Alfalfa hay is grown as a feed for dairy cows, and, to some extent, is grown for sale by limited numbers of farmers in all parts of the infested area. It should be considered as an alternative if the corn acreage is to be reduced. The acreage of barley grown in northwestern Ohio and southeastern Michigan was increased slightly in 1927, partly because of the corn borer. Barley may become more important on some farms as an alternative grain crop. Truck crops are grown in parts of the infested area, especially around the industrial centers along the lake.

The average yield of corn in much of the present infested area (especially in northwestern Ohio and southeastern Michigan) is approximately 40 bushels an acre. From the standpoint of average yields and average prices, sugar beets and alfalfa are the only crops now commonly grown on general farms in the infested areas which compare favorably with corn from the standpoint of gross value per acre. (Fig. 10.) The gross values per acre and the value after deducting actual cash outlays for the production of sugar beets, corn, alfalfa, wheat, and barley in northwestern Ohio and southeastern Michigan are about as follows:

	Gross value per acre	Value after actual cash outlays are deducted
Sugar beets	$56.00	$31.40
Corn	28.00	27.80
Alfalfa	30.00	24.50
Wheat	21.25	16.85
Barley	17.50	14.40
Oats	14.00	11.10

Sugar beets compare more favorably with corn as a revenue producer than does any crop now grown to a considerable extent in the area that comprises northwestern Ohio, northeastern Indiana, and southeastern Michigan. Information obtained from farmers in this area, in the summer of 1927, indicates a slight tendency to shift a part of the corn acreage to sugar beets. As sugar beets must be cultivated, the crop fits well into the usual crop rotation in this area. Aside from the contract labor and that of hauling the beets to the factory or shipping station, the labor on sugar beets does not differ greatly from that used on corn, either as to the amount of work or the time when the work must be done.

Before substituting sugar beets for all or a part of the corn acreage, however, a farmer must consider the adaptability of his soil to sugar beets, the marketing facilities and market outlets available, and the cost of hauling beets to the factory or shipping station. Where all of the corn and stalks are utilized for feed, the substitution of sugar beets will necessitate the purchase of more feed or the reduction of the livestock enterprises. In addition, the labor problems involved in sugar-beet production are usually more difficult than in the case of corn or the small-grain crops.

In considering an alternative like alfalfa, as a crop for sale in the place of corn, it must be recognized that any pronounced increase in the acreage of alfalfa grown for sale might make it necessary to ship to more distant markets, with resulting lower prices to the farmers in this area. Increased acreage of oats, barley, wheat, and sugar beets would not have any marked effect upon their prices until a much larger territory is affected.

Neither of the small-grain crops, wheat or oats, now extensively grown in the infested area in rotation with corn, compares favorably with corn as a revenue producer. Wheat compares more favorably than oats from the standpoint of value per acre, but in the cash-grain area of northwestern Ohio and northeastern Indiana oats are grown more extensively after corn than is wheat because of the difficulty of seeding winter wheat in the fall after corn, and the frequent winter killing.

Oats and barley are the other grain crops usually mentioned as possible substitutes for corn as feed grains. Considering average yields in the infested area of northwestern Ohio and southeastern Michigan, the bushels and pounds of grain grown per acre of these crops are about as follows:

	Bushels per acre	Pounds per acre
Corn	40	2, 240
Barley	25	1, 200
Oats	35	1, 120

The additional pounds of corn grown per acre are sufficient to indicate the superiority of corn as a feed crop in this area, although it is possible that the yields of oats and barley would be increased by the use of better yielding varieties and the adoption of better cultural methods.

Because of the smaller amount of feed grown per acre the extensive substitution of oats or barley for corn, on farms where practically all of the corn is used for feed, would make it necessary to reduce the number of livestock or purchase additional feed or enlarge the area of grain crops grown for feed.

The disadvantage of the small-grain crops as compared with corn, from the standpoint of feed produced per acre or net value per acre, is partly offset by the smaller amount of labor ordinarily used in small-grain production and the fact that they are harvested early, which gives more time in the fall for seed-bed preparation and other fall work. Corn ordinarily requires almost twice as much labor per acre for its production as do the small-grain crops. The labor on corn, however, is distributed fairly evenly throughout the year, whereas that on small-grain crops is concentrated during the two very busy seasons of seeding and harvest. Consequently more labor must ordinarily be hired for the work on small-grain crops than for the work on corn, which can usually be done without additional expense for hired labor.

The small-grain crops in this area are now grown almost entirely in rotation with corn and with only a limited amount of time devoted to the preparation of a special seed bed. Any pronounced increase in the acreage of small-grain crops at the expense of corn would result in the necessity for more plowing if two or more small-grain crops are grown in succession. It would also increase the amount of work to be done during the rush season of small-grain harvest in the summer.

In most of the infested area the size of farms is influenced to a considerable extent by the acreage of corn which a farmer can handle with a given labor supply or with one set of tools for cultivating or harvesting. In such cases substantial changes in corn acreage, or the extensive substitution of small-grain crops for corn, may involve corresponding adjustments in the size of farms. Changes of this type usually come about very slowly and should await developments with respect to commercial damage by the borer and the effectiveness of control practices which may be incorporated with present production practices without adding materially to the actual cash expense of farm operation.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

January 20, 1928

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U. S. DEPARTMENT OF
AGRICULTURE
FARMERS' BULLETIN No. 1563

CUCUMBER GROWING

1862 1889

TABLE OR SLICING CUCUMBERS are grown for the market in 29 States, but the main car-lot movements originate in 14 States.

The markets are now well supplied, and the present outlook for table-cucumber consumption in the United States does not warrant any great expansion of acreage.

Average gross returns from field-grown cucumbers during the period from 1924 to 1926 were about $180 an acre, with an average production cost of approximately $100 an acre.

The forcing of early spring cucumbers in coldframes has become a highly specialized industry, mainly in the Norfolk, Va., section.

The market requirements are for cucumbers that are fresh, crisp, of medium size, dark green in color, clean, and uniformly graded.

This bulletin contains cultural directions for growing table or slicing cucumbers in coldframes and as a field crop. For information on the production of cucumbers in greenhouses the reader is referred to Farmers' Bulletin 1320.

This bulletin supersedes Farmers' Bulletin 254, Cucumbers.

Washington, D. C. June, 1928

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CUCUMBER GROWING

By W. R. BEATTIE, *Horticulturist, Office of Horticulture, Bureau of Plant Industry*

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REVIEW OF THE INDUSTRY

CUCUMBERS are included among the 20 important commercial truck crops that are shipped to the markets of the United States in large quantities. The area planted to cucumbers for table purposes in 1926, as reported by the Bureau of Agricultural Economics,[1] was 39,210 acres, the crop produced being valued at $6,756,000. This acreage is exclusive of approximately 68,000 acres of cucumbers grown for pickles and also of the crop produced in greenhouses. This bulletin deals only with the production of table or slicing cucumbers as a field crop and those grown in coldframes during the early part of the season.[2]

Fresh or table cucumbers are grown for car-lot shipment in 29 States, and in large quantities in 14 of them. Florida was the largest shipper in 1926, having shipped 1,982 of a total of 7,180 cars shipped by the entire cucumber-producing territory. The shipment of cucumbers to the larger markets is divided into three seasonal periods—early, intermediate, and late. The early-shipping section includes Alabama, Florida, Georgia, Louisiana, South Carolina, Texas (southern portion), and Virginia (sash grown). The intermediate territory includes North Carolina, Virginia (field grown), Arkansas, Delaware, southern Illinois, Maryland, and New Jersey, although New Jersey might be considered in both the intermediate and the late territory. New York is the outstanding State in the production of late cucumbers, although New Jersey, Michigan, Maryland, Illinois, Delaware, Ohio, and central California are shipping at the same time.

Table 1 shows the carload shipments of cucumbers from 1920 to 1926. Florida ships during two seasons of the year, the first, including October, November, and December; the second, April, May, and June; May being the heaviest shipping period for this State. Florida shipments are followed or overlapped by those from South Carolina, North Carolina, Louisiana, Virginia, and the southern part of California. Table 2 gives the acreage, yield per acre, and price per unit of cucumbers grown for the market in the 14 principal producing States for the period 1924–1926.

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[1] UNITED STATES DEPARTMENT OF AGRICULTURE. STATISTICS OF TRUCK CROPS FOR SHIPMENT, 1924–1926. U. S. Dept. Agr. Crops and Markets Mo. Sup. 3: 411. 1926.

[2] Information relative to the growing of cucumbers under glass is given in BEATTIE, J. H. THE PRODUCTION OF CUCUMBERS IN GREENHOUSES. U. S. Dept. Agr. Farmers' Bul. 1320, 30 p., illus. 1923. The production of cucumbers for pickles is a distinct industry and is reserved for treatment in a separate bulletin.

TABLE 1.—*Car-lot shipments of cucumbers, by State of origin, 1920–1926* [1]

[Reported by Bureau of Agricultural Economics; see footnote 1, p. 1]

State	1920	1921	1922	1923	1924	1925	1926 [2]
	Cars	*Cars*	*Cars*	*Cars*	*Cars*	*Cars*	*Cars*
New York	312	540	395	383	694	686	444
New Jersey	287	271	164	258	276	481	259
Ohio	52	118	124	68	111	91	187
Illinois	142	164	68	15	77	245	151
Delaware	256	137	191	225	240	302	304
Maryland	297	343	368	446	311	598	487
Virginia	83	19	221	84	387	448	202
North Carolina	408	641	687	1,175	1,639	1,562	869
South Carolina	525	664	887	720	918	794	668
Georgia	1	3	211	45	154	72	62
Florida	835	1,414	2,034	1,647	1,381	1,963	1,982
Alabama	259	109	702	367	576	706	684
Texas	95	64	119	46	147	72	316
California	----------	89	68	125	23	125	86
Other States	137	256	110	96	248	347	479
Total	3,689	4,832	6,349	5,700	7,182	8,492	7,180

[1] Shipments as shown in car lots include those by boat reduced to car-lot basis. [2] Preliminary.

TABLE 2.—*Fresh or table cucumbers, commercial crop: Acreage, production, and prices per hamper, by States, 1924–1926*

[Reported by Bureau of Agricultural Economics; see footnote 1, p. 1]

State	Acreage			Production			Price per hamper [1]		
	1924	1925	1926	1924	1925	1926	1924	1925	1926
Early:	*Acres*	*Acres*	*Acres*	*1,000 hampers* [2]	*1,000 hampers* [2]	*1,000 hampers* [2]	*Dollars*	*Dollars*	*Dollars*
Alabama	2,540	2,240	2,880	432	417	472	0.77	1.48	0.56
Florida	12,370	10,830	7,590	1,002	1,256	1,108	3.30	2.36	2.51
Georgia	2,260	610	720	120	70	67	1.20	1.15	.85
Louisiana	540	1,800	2,810	108	139	292	1.77	1.96	1.59
South Carolina	3,560	2,900	4,120	605	458	490	.57	1.58	1.02
Texas (southern district)	950	980	2,800	163	66	333	1.70	2.14	1.55
Virginia	1,730	1,560	1,640	260	257	205	.80	.75	1.15
Second early:									
North Carolina	3,560	5,310	4,570	890	860	530	.94	.93	1.13
Intermediate:									
Arkansas	500	1,410	1,760	50	151	150	1.11	1.04	1.01
Delaware	740	1,480	1,630	118	167	184	1.71	.57	.70
Illinois (southern)	520	740	560	104	130	67	1.58	.80	.78
Maryland	1,420	2,080	2,080	220	416	260	1.54	.53	.56
New Jersey	2,000	2,500	2,100	342	500	420	1.55	.67	.95
Late:									
New York	3,400	4,490	3,950	544	516	490	1.54	.60	.94
Total or average	36,090	38,930	39,210	4,958	5,403	5,068	1.57	1.30	1.33

[1] Average for season. [2] Bushel hamper.

Table or slicing cucumbers are classed as a salad vegetable for which there is a demand especially during the spring and early summer months. Although they do not form one of the major vegetable crops grown in the United States, their production is a source of considerable farm income. The growing of high-grade table cucumbers is rather difficult, owing mainly to the prevalence of insects and diseases which must be overcome by spraying and by other special methods. Yields and prices were fairly uniform during the three-year period 1924–1926, and the production of cucumbers as a field crop was reasonably profitable. There were, however, short intervals during this period in which the markets were temporarily overstocked and prices therefore low. The average yield of field-grown cucumbers for three years as shown in Table 2, is only about 135 bushel hampers per acre, and the average price was between $1.30 and $1.40 a hamper, a maximum gross return of approximately $180 an acre. The production costs for field-grown cucumbers are, as a rule, in the neighborhood of $100 an acre. Thus only a fair margin of profit remained.

The present outlook for table-cucumber consumption in the United States does not warrant any great expansion of acreage, and there is need for more intensive culture and the production of higher grade table stock. This is particularly true of the sections where the crop is grown in the field, as the frame industry leaves little to be desired in the way of quality of product or intensity of cultural practices. It is estimated that there are about 150 acres in the Norfolk region devoted to the growing of cucumbers under sash. This industry has developed during the last 25 years and on the whole has been fairly profitable. At present, however, production costs are so heavy as to render the sash growing of cucumbers rather hazardous; in fact, only the best growers claim to be making any money. Gross returns from an acre of frames range from $1,000 to $2,000 for the cucumber crop alone, but high production costs very greatly offset these large returns.

The growing of cucumbers under sash is essentially a modification of intensive field culture, by which the hazards of early planting are largely eliminated through the use of greenhouses for starting the plants and by growing the crop to an advanced stage in coldframes. This system has the advantage of greatly lengthening the season, considerable quantities of cucumbers being marketed before the outdoor crop is much more than planted. In some instances the frame-grown plants continue to produce until midsummer and after the field crop has been plowed under.

SOIL AND FERTILIZERS

Cucumbers can be grown on almost any good soil. The commercial crop, however, is produced largely on the sandy loams of the Gulf coast and Atlantic coast regions. A soil consisting of from 14 to 18 inches of dark sandy loam overlying a close sand or medium clay subsoil is ideal, especially if the natural water level of the area is within 8 or 10 feet of the surface, thus assuring an ample supply of subsoil moisture. The intensive hotbed and coldframe crop of the Norfolk region is produced on highly fertilized sandy loam. In Florida and elsewhere in the Atlantic and Gulf coast regions the field crop is grown by the aid of considerable quantities of commercial fertilizers. In order to avoid diseases, it is essential that cucumbers be grown in long-period rotations and on new land or that which has not been used for any of the vine crops for at least three or four years preceding.

Good drainage, together with moisture-holding power, is essential in soils on which cucumbers are grown.

Even where considerable manure is available, one or more of the soil-improvement crops should be included in the rotation and these turned under to enrich the soil and add humus. Where a winter cover crop is grown on the land it will be necessary to turn it under at least two or three weeks in advance of planting. Where only a limited quantity of manure is available, it can be used to best advantage by placing it in furrows underneath the rows, or if the plants are to be grown in hills, the manure can be mixed with the soil composing the hills. In field culture the manure is sometimes applied by means of a manure spreader in a narrow strip where the rows are to be located. In the Wilmington, N. C., district, cucumbers follow early spring lettuce, the cucumber crop in turn being followed by soil-improvement crops. In Florida, velvet beans are largely used as a soil-improvement crop.

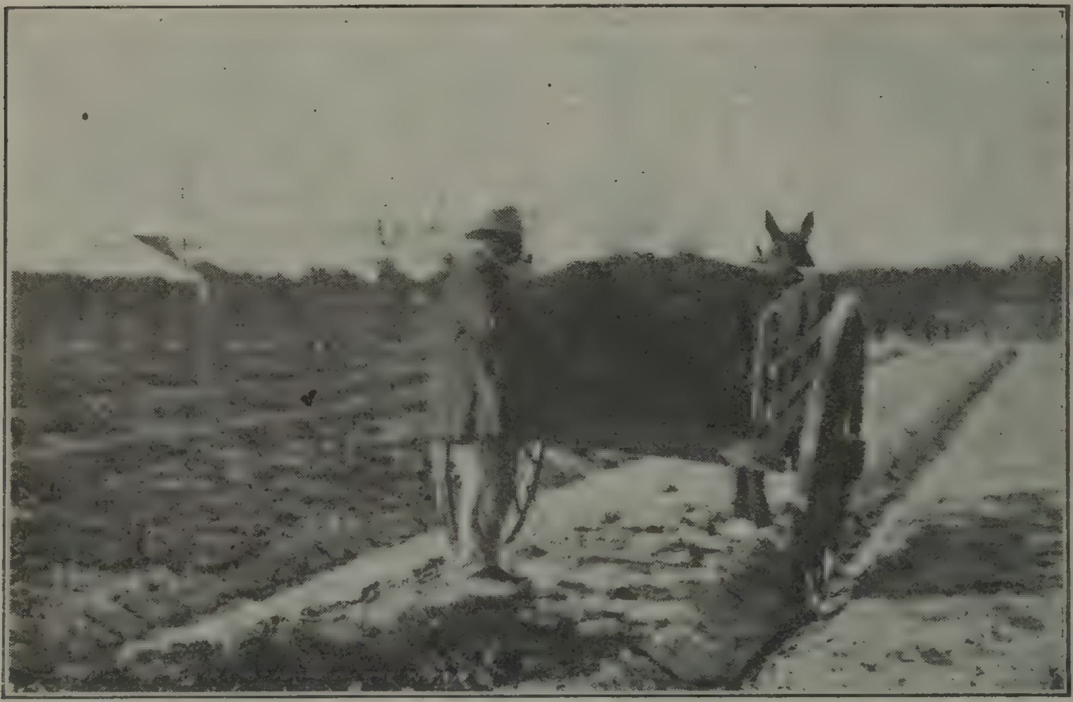

FIG. 1.—Fertilizing cucumber beds in the Norfolk, Va., region during early December

The frame growers of the Norfolk-Portsmouth, Va., region usually grow a crop of soy beans, sorghum, rye, or cowpeas on their land during the late summer and turn these crops under for soil improvement. They also apply 70 to 100 tons of manure to the acre each year. The manure is first thoroughly composted and a portion of it spread upon the beds during the early winter as shown in Figure 1. A week or two in advance of setting the cucumbers the remainder of the manure is placed in a furrow through the middle of the beds and completely mixed with the soil by means of a one-horse cultivator prior to rebedding the ground for planting.

Commercial fertilizers containing 4 to 5 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 4 to 5 per cent potash are applied broadcast at the rate of 1 ton to the acre by most southern cucumber growers. In outdoor culture the entire 2,000 pounds is sometimes applied before planting; in other cases only about 1,200 pounds is applied in advance and the remainder is used in the form of side dressings during the growing period. In frame culture about 2 tons of high-grade commercial fertilizers are applied during the season, one-half of which is worked into the soil in advance of planting the crop, and the remainder is used as side dressings during the growing season. As a rule, a crop of early beets is grown on the land in the spaces between the cucumber beds, and additional fertilizers are applied to the beets.

Nitrate of soda is frequently used as a stimulant for both the frame-grown and the field-grown cucumber crops during the growing season, applications of 100 to 200 pounds per acre being made by turning back the vines and drilling or broadcasting the nitrate along the rows. In some cases a small furrow is opened into which the nitrate is scattered and the furrow is then turned back in place. The frame-cucumber growers of the Norfolk section frequently dissolve the nitrate of soda in the tanks from which water is drawn for watering the plants in the beds. The nitrate is placed in the tank and the water stirred until it is all dissolved and uniformly mixed. The plants are then given a moderate watering with this solution, which greatly stimulates their growth. The nitrate should be used at a rate not exceeding 50 pounds to each 7,000 or 8,000 gallons of irrigation water. Complete fertilizers containing as high as 7 to 10 per cent of readily available nitrogen are frequently used for side dressings, both on the field and on the frame cucumber crops, instead of nitrate of soda or other form of readily available nitrogen, without the addition of phosphoric acid and potash. When dissolved in the irrigation water, nitrate of soda seems to give the quickest response, but for permanent results many growers prefer to use a complete fertilizer.

The fertilizer requirements of cucumbers depend to a considerable degree upon the supply of organic matter in the soil and especially on the extent to which this matter is derived from animal manures. In southern field culture where little manure is available a combination of soil-improvement crops and commercial fertilizers is relied upon to meet the plant-food requirements of the cucumber crop. In view of the fact that high-grade fertilizer ranges in price from $36 to $48 a ton according to location and grade, which alone constitutes an important item in cucumber production costs, and that the average returns from field-grown cucumbers are about $180 an acre, the initial expenditure of $40 to $50 for fertilizer greatly reduces the ultimate profits. Gross returns from the specialized frame culture of cucumbers are of course much higher, thus justifying a greater expenditure for fertilizers.

SOIL PREPARATION

Soils of the character on which cucumbers are usually grown are relatively easy to prepare. The more successful growers disk and harrow the land several times after plowing in order that all manure and fertilizers may be thoroughly mixed with the soil. The Norfolk frame growers plow their land in the late fall, apply a heavy coating of manure, and disk the soil several times to work in the manure.

As the main considerations are earliness, quality, and a fairly long picking season, thorough preparation of the soil is essential, especially where production costs are high. The methods of soil preparation depend upon locality, as, for example, throughout the South Atlantic and Gulf Coast States the land is bedded, the height depending upon drainage conditions, and the seed is planted on top of the bed. In other sections the land is plowed and harrowed broadcast, the rows are marked off, and the seed is planted on the level or in a slight furrow. In sections where irrigation is practiced the land is plowed in beds with irrigation furrows between, and the seed planted just above the water level of the furrow.

Where a soil improvement crop is grown during the late summer, it is plowed under before it is killed by frost. The land is then disked at intervals until November or December, when the manure is applied and the land again disked two or three times. The final preparation of the land begins about a month in advance of planting. In Florida, soil preparation proceeds at any time during the late fall and early winter. The beds are thrown up somewhat higher than is required for planting, then are harrowed or dragged to a lower level, in many cases almost flat, before planting.

VARIETIES

White Spine, or varieties of that type, are most commonly grown in field culture. (Fig. 2.) Early Fortune, a strain of White Spine, is one of the most popular. A number of other strains of White Spine are also popular. The variety known as Black Spine has been used in many instances for making crosses with White Spine, giving a deep-green color to the varieties or strains so produced. The Improved Long Green, a variety of the Black Spine type, is being used extensively for field planting. The majority of the frame growers of the Norfolk district have developed special strains of their own, most of which, however, are of the White Spine type. Formerly the variety known as Davis Perfect was extensively grown in parts of the South, but on account of being too large for proper grading it has been largely replaced by a strain known as Kirby Stay Green.

SEED SUPPLY

Too much stress can not be placed on the importance of good seeds. In view of the fact that less than 2 pounds of seed is required to plant an acre, the grower may well afford to pay a reasonably high price provided he is getting the quality represented. Certain seed houses are now meeting the demand for superior seed, in many cases treating the seed with organic mercury compounds to reduce the possbility of carrying to the fields any of the so-called seed-borne diseases. Cucumber seed retains its vitality from three to five years if kept under proper conditions of moisture and temperature. Reasonably fresh seed, however, is recommended. Many of the most successful cucumber growers have their own strain and save their seed from specially selected cucumbers. It is essential, however, that no cucumbers of inferior strain or of another variety be grown near by, as bees are certain to carry the pollen and cause mixtures.

PLANTING THE FIELD CROP

Because cucumbers are susceptible to frost injury, planting in the field must necessarily be delayed until danger of frost is past. In some sections paper caps or covers are being used to protect the young plants, a week to 10 days being gained thereby in earliness of planting. As a general rule, however, it is not safe to put the seed in the ground until the soil is fairly warm. Some growers follow the practice of planting three lots of seed, the first being placed in the ground about 10 days or two weeks before the date of the average last killing frost for the locality, the second about a week later, and the third after both the first and second lots have appeared above the ground. If the first planting is not lost, it gives an extra-early crop. In some cases the first planting will be killed by frost and the second will come through the ground after the frost and form the basis for the crop. In a few instances both the first and second plantings are killed, in which case the third planting must be relied upon for a stand.

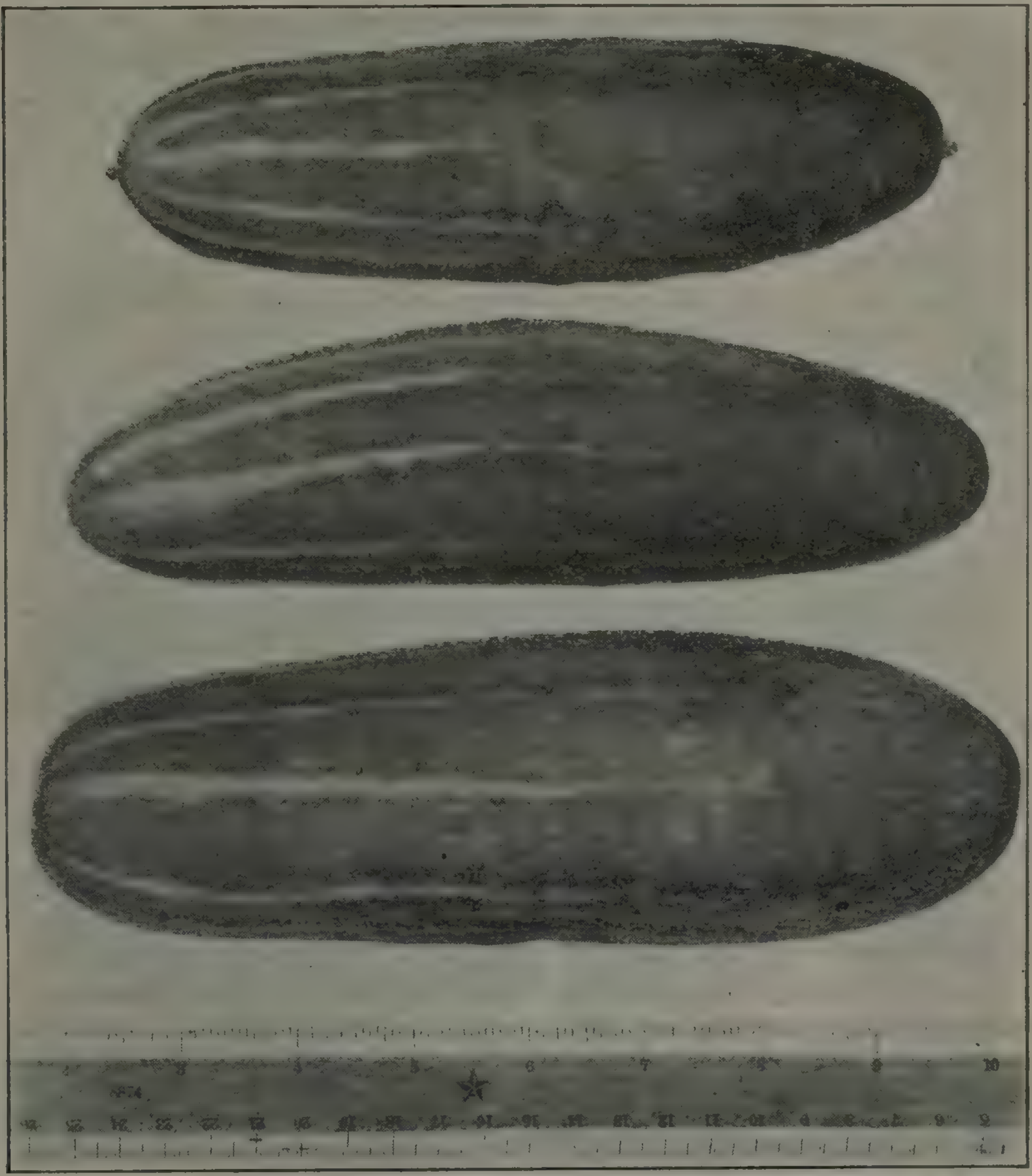

FIG. 2.—Typical cucumbers of the White Spine type. The large specimen is overripe, the two smaller ones being about right for marketing

The final preparation of the soil usually consists of smooth harrowing or dragging just before planting the seed. In case of rain between the time of applying the fertilizer and planting, the land is given a light harrowing or dragging ahead of the planter. Many growers prefer to apply the fertilizer during this final preparation, in which case the work is done directly ahead of the planters.

Where the cucumbers are planted in hills the land is usually marked in both directions and the seed planted in the intersections. If the planting is in one direction only the land is marked one way and the planter run in the mark. Frequently a marker is attached to the side of the planter and the land marked and planted at one operation. Horse-drawn planters are used wherever the acreage is sufficiently large to warrant this, or an ordinary hand planter with wheel in front is used. Care must be taken that the average planting machine does not put in too much seed.

Planting distances vary with the locality. Where the cucumbers are grown in hills, the hills are usually spaced 6 by 6 or 6 by 8 feet apart. When the planting is in rows, the rows are placed 4 to 8 feet apart and the plants thinned so that they stand 2 to 3 feet apart in the row. Wider spacing of rows and thinning to a single plant every 6 or 7 feet in the row has been found under most conditions to give better yields than are obtained by closer spacing. Cultivating, spraying, and picking are all made easier by wide spacing, and there is the suggestion that both insects and diseases may not be so troublesome where the vines do not mat together. Where the crop is grown in beds, the beds are generally 4 to 6 feet in width, the row being directly on top. In irrigated sections the row is placed on the south side of the bed and on the edge of the irrigation furrow, the seed being planted in hills. After the beds are made and the irrigation furrows opened, the water is admitted to the furrows to establish a level which serves as a guide in planting. The water is then shut off and the seeds are planted in hills just above the water level. A second irrigation is frequently given to supply the moisture necessary to sprout the seeds.

Where cucumbers are planted in checks or hills, 9 or 12 seeds are placed in each hill by hand and covered about an inch deep, but if planted in rows the seed is scattered thinly along the entire row. In planting in beds a slight furrow is opened through the middle of the bed and the seed planted in this furrow, or the seed drill is run in the middle of the bed. Cucumbers require thinning, as a rule four to six plants being left in each hill at the first thinning, these being reduced to two or three plants after they have become well established. Where the cucumbers are planted in a continuous row, the initial thinning can be done with a hoe at the time of the first hand-hoeing, but the final thinning to a proper stand should be done by hand after the plants become well established.

PROTECTION FROM COLD IN THE FIELD

Paper caps are sometimes used to protect the hills of cucumbers during the first week or 10 days in the field. These caps are put on as soon as the seed is planted and are kept over the young plants until danger of severe cold is over. Paper caps are not adapted for the protection of plants after the plants attain any considerable size.

In Florida the growers frequently use a protection consisting of two cypress boards nailed together in the form of a V-shaped trough. These troughs are turned over the rows of cucumbers at night and during extremely cold days, but in the daytime are placed to one side of the row, where they serve as a windbreak for the plants. (Fig. 3.)

In order to derive the greatest benefit from wind protection, the rows are run at right angles to the direction of the prevaling winds. The troughs are so placed during the day as to gain the greatest benefit from the sunshine on the young plants.

Small boxes covered by a pane of glass are also used as protectors to some extent. The bulk of the field-cucumber crop, however, is grown without special protection.

PLANTING THE FRAME CROP

Cucumbers grown in frames are started in greenhouses (fig. 4) and transplanted to the frames, earliness being the main objective. In the Norfolk area the seed is sown about February 24 or 25 in a small bed in a greenhouse heated by pipes buried in the soil at intervals of 12 or 14 inches and about a foot below the surface Hot water from the greenhouse boiler circulates through these pipes, raising the temperature of the soil to about 80° or 82° F. The soil is warmed and properly moistened several days in advance of planting the seed. On the appointed date, usually three days before March 1, the seeds are sown in drills in this heated bed, covered lightly, and kept properly moistened. In three or four days the seedlings are ready for transplanting. They are then carefully lifted and placed in 5-inch or 6-inch flowerpots filled with excellent and well-enriched potting soil, seven to nine plants being set in each pot. The pots are then placed on the greenhouse benches and a temperature of 65° to 80° maintained in the house, with proper ventilation, during a period of about four weeks. In the meantime the plants are thinned, first to four or five in a pot and later to three. At the end of four weeks under proper management the plants will have formed about three true leaves as shown in Figure 5, and will begin to crowd, making it necessary to separate the pots 2 to 3 inches on the greenhouse

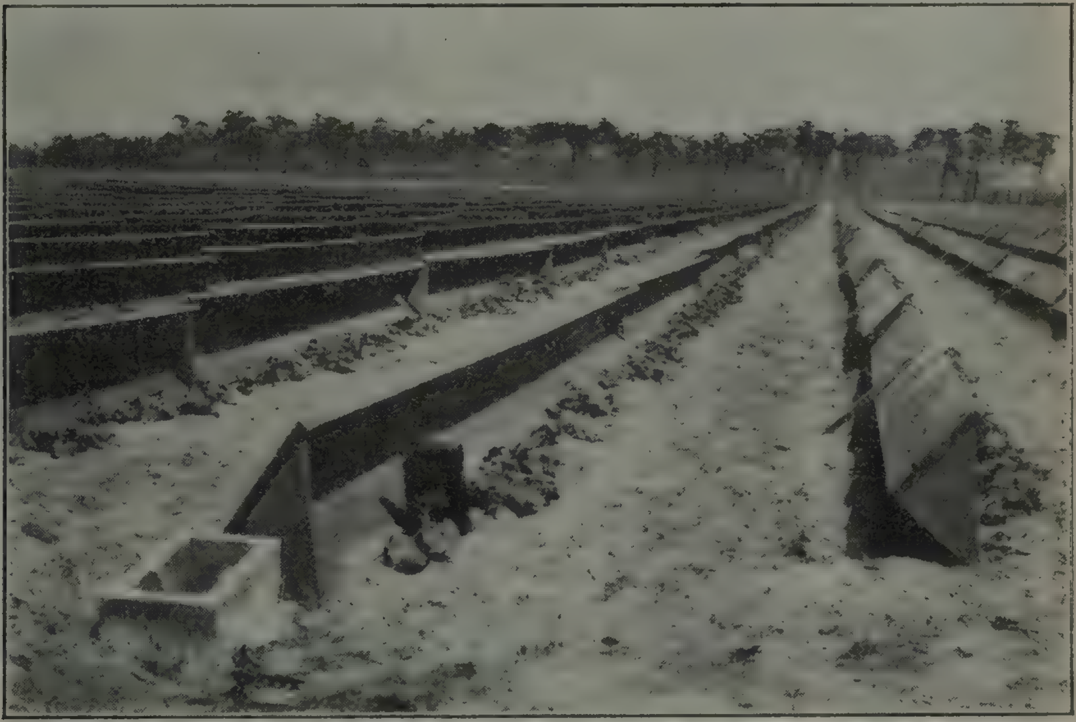

FIG. 3.—Wooden troughs used for protecting young cucumber plants in Florida

benches. Contrary to the general belief that cucumbers can not be readily transplanted, the sash growers of the Norfolk region have been following this practice successfully for many years.

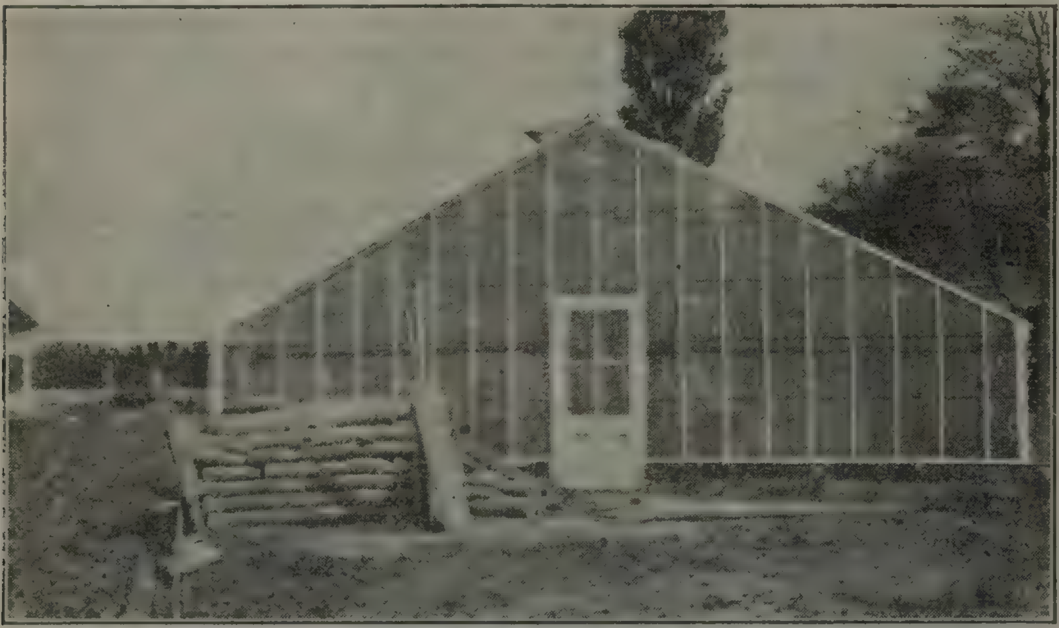

FIG. 4.—Type of greenhouse used for growing early cucumber plants for setting in coldframes. Note in the foreground the stack of flowerpots in which the plants are grown

During the time that the plants are being grown in the greenhouse the coldframes are prepared for the transfer of the plants to them. The frames consist of two parallel lines of boards, a 1 by 12 inch board at the north side and a 1 by 6 inch board at the south side, set on edge and fastened to stakes. The sash simply rest upon these boards, no crosspieces being provided. In preparing the beds for planting, a deep, broad furrow is opened through the center and partly filled with well-rotted manure. The manure is then mixed with the soil in the bottom of the furrow, the soil turned back over the manure, and the surface harrowed, leaving a slight depression or broad furrow through the center of the bed. The sash are then placed on the frames and the beds allowed to become warm from the heat of the sun. In setting the plants in the beds the pots containing them are taken to the frame yard and the ball of earth carefully jarred loose from the pot and set in the bed, one hill directly under the center of each sash. As the plants are set they are watered, the sash replaced, and careful attention given to the ventilation, also to protecting the plants from cold drafts and severe wind until they become well established.

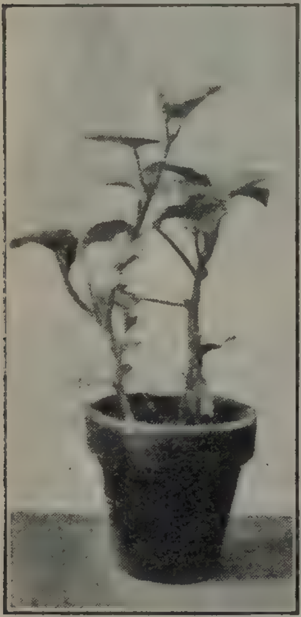

FIG. 5.—Greenhouse-grown cucumber plants ready for setting in coldframes

MANAGEMENT OF FRAMES

Temperature control of the beds is very important, and although a maximum of 85° F. is permissible, care must be taken to provide ventilation to prevent overheating. Ventilation is obtained by propping up the sash, always on the side opposite the wind, 4, 6, or 12 inches as required, by means of small notched boards, as shown in Figure 6. The passing of a small cloud on a bright but chilly day will frequently reduce the temperature in the beds 10° to 20° and require that the sash be lowered, but with the return of the sunshine the sash should again be raised. The more successful sash growers keep a man stationed on each acre of sash during daylight hours, his main duty being to watch the thermometers in the beds and to regulate the temperature. Night temperatures are controlled to considerable extent by closing the beds early in the evening and, in extreme cases, placing a thin layer of straw or marsh hay over the glass.

WATERING IN FRAMES

Watering frame-grown cucumbers is almost as important as temperature control, but its frequency depends upon weather conditions. If the weather is cloudy, very little watering will be required; on the other hand, if the weather is bright and there is considerable wind, watering will be necessary two or three times a week. Water is applied with a 1-inch hose usually in the morning when the temperature is rising, a man and a boy working together, the boy going ahead raising the sash, and propping each about a foot high while the man does the watering. The beds are then closed immediately unless the temperature is such as to require their being left open. The quantity of water will depend upon the condition of the soil. The water is applied in a soft stream from a hose without a nozzle, the stream sometimes being spread by holding the thumb or finger lightly over the end of the hose. The precaution should always be taken to apply the water to the soil without greatly washing or injuring the plants. After the removal of the sash and frames, water is applied by means of lines of sprinkler pipe supported on stakes about 24 inches above the ground.

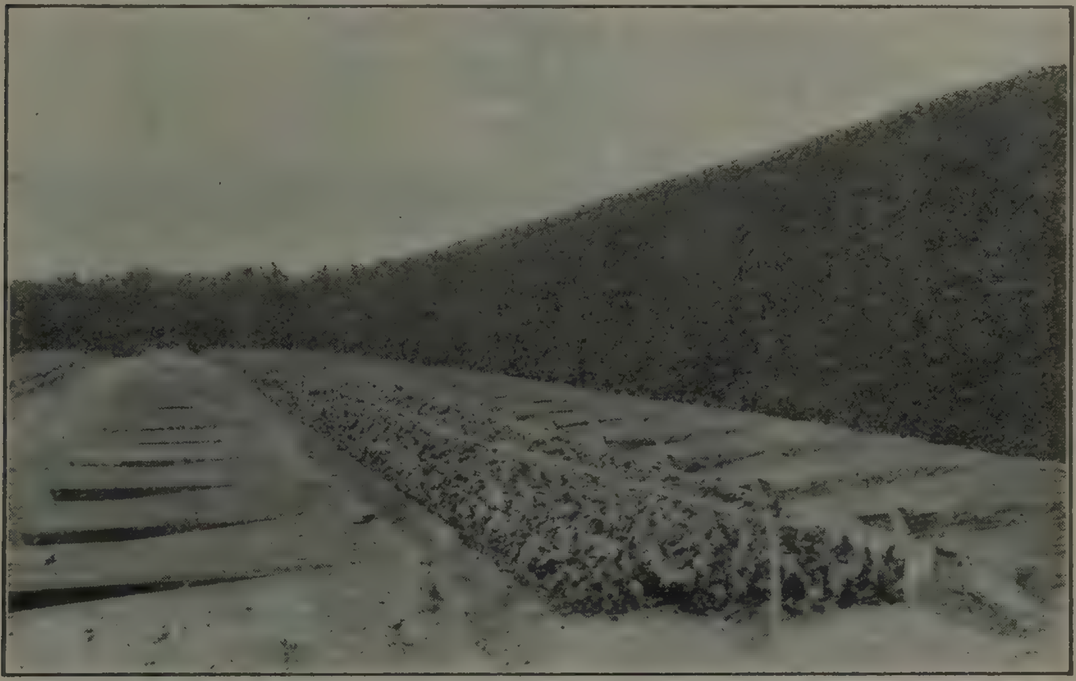

FIG. 6.—Cucumber frames with a crop of early beets in the spaces between the frames. Originally over the beets, these frames were simply moved over for the cucumbers. The method of ventilating the frames is also shown

CULTIVATION IN FRAMES

Cucumbers grown in frames are cultivated and fed with fertilizer from the very start. The plants are hand-hoed about once a week until the vines completely fill the 6-foot beds. After all danger of cold weather is past the sash are removed and stored in sheds, and the board sides of the frames are taken away. The 6-inch board at the front of the frame is first removed, the 12-inch board being left at the rear for protection. Later, this is also taken away, the vines are turned slightly, and the soil is cultivated under them. The vines are again spread and allowed to occupy the entire area between the beds, as shown in Figure 7. Large quantities of cucumbers are often marketed from the frames before the removal of the sash, but the heaviest pickings occur about the middle of June, after both the sash and the frames have been removed.

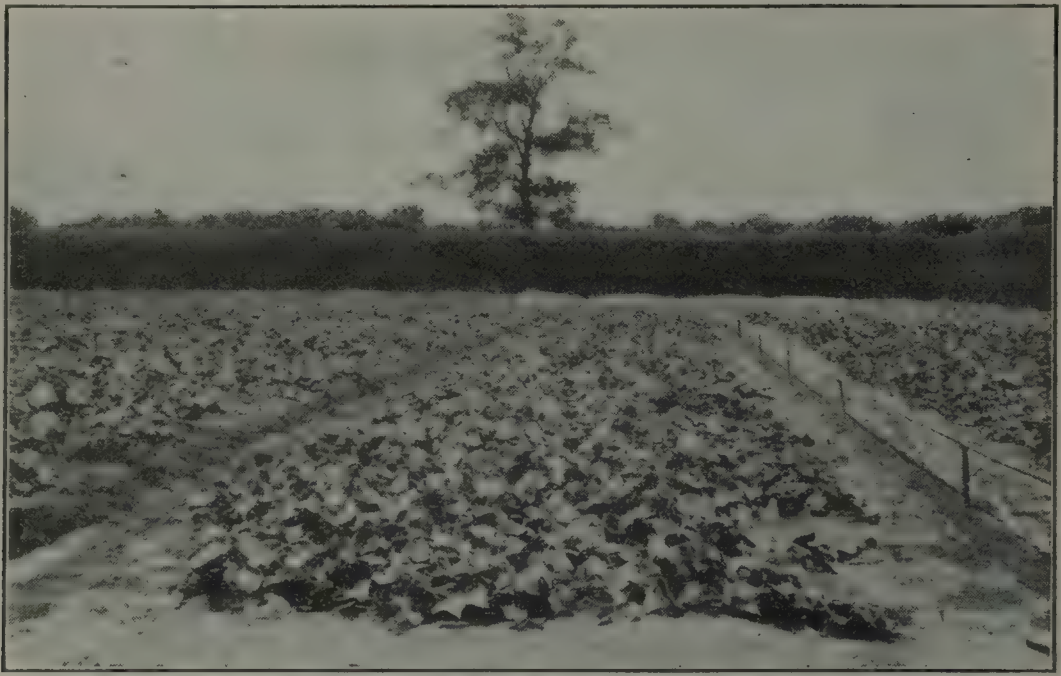

FIG. 7.—Frame-grown cucumbers in the Norfolk, Va., district. Photographed June 14, in the same location and 30 days later than that shown in Figure 6. Note the windbreak of California privet growing to a height of 12 or 14 feet

POLLINATION OF CUCUMBERS

Pollination, or the setting of fruit, on cucumber vines is dependent upon some outside agency such as bees. Two kinds of flowers are found on every fruiting cucumber plant—the male ones (fig. 8), which supply the pollen, and the female ones (fig. 9), which produce the cucumbers. Both can be readily distinguished, as the female flower is borne on the outer end of the little cucumber. Generally the male flowers appear in great abundance in advance of the female flowers, which leads to the erroneous notion that the cucumbers are failing to set fruit. Later, the female flowers appear, and fruit is formed. Cucumbers grown in the field are pollinated by either tame or wild bees from the neighborhood. Under favorable conditions, cucumbers grown in frames may become pollinated by natural agencies, but the sash growers of the Norfolk region provide stands of bees near their frames when the cucumbers are setting in order to insure perfect pollination. Without proper pollination the cucumbers are deformed, or at least a considerable percentage of nubbins are produced. In localities where bees are scarce it is advisable for the growers of cucumbers in fields to maintain bees, in order to insure pollination.

INSECT ENEMIES

STRIPED CUCUMBER BEETLE

Of the insects that attack the cucumber crop, the striped cucumber beetle is the most troublesome. The first of these beetles emerge from their winter quarters in the late spring, and as the seedling cucumber plants break through the ground they are attacked. The beetle feeds upon the tender seed leaves and the stems. The latter are attacked below the surface of the soil where cracks in the soil offer means of entrance to the beetles. Prompt control measures are essential to protect the crop. A 3 per cent nicotine dust applied directly to the hills of small cucumbers with a box duster or with a bellows duster equipped with a cone nozzle is fairly effective, 15 to 20 pounds being required to cover an acre. When cucumbers are planted in rows, from 30 to 35 pounds of the dust will be required to the acre. To be effective the dust must be applied when the air temperature is above 70° F. and when the foliage of the plant is dry. This temperature factor precludes the use of nicotine dust in some sections. The first application is made at the first appearance of the beetles, this being followed by as many treatments as may be necessary to prevent injury.

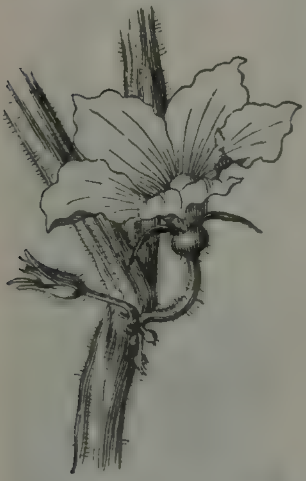

FIG. 8.—The male or staminate flower of cucumber

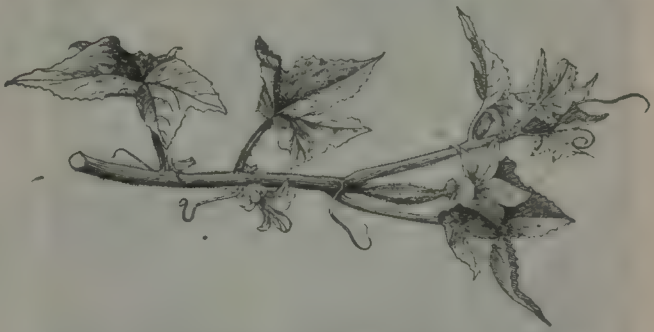

FIG. 9.—The female or pistillate flower of cucumber

A 3 per cent nicotine dust may be prepared by adding 1 pound of nicotine sulphate (containing 40 per cent of actual nicotine) to each 12⅓ pounds of hydrated lime and rolling for 15 or 20 minutes in a closed can or barrel containing one-half pound of stones or pebbles to each pound of dust. Nicotine dust may be purchased already prepared. Consult your county agent for information as to where it can be obtained. The dust should be kept in air-tight containers until used, but it is best to mix it only as needed. Figure 10 shows a bellows-type duster equipped with a cone nozzle, and Figure 11 shows a box duster, both of which are useful in the control of the striped cucumber beetle.

In the operation of the bellows duster, the cone nozzle is placed over the hill of plants, the handle of the duster given one stroke, and the cone allowed to remain over the hill for a second or two, thus preventing the beetles from escaping while the dust is concentrated upon the hill.

The box duster is operated by dropping it over the hill with a sufficient jar to cause a small quantity of dust to sift through the burlap bag upon the plants. The box also is allowed to remain over the hill a second or two, and as the operator walks slowly along the row the duster is moved from one hill to the next with only a short pause in the stride of the operator. Tightly covered cans containing a supply of the dust from which to replenish the small dusters should be placed at convenient points in the cucumber field. One man will cover from 8 to 10 acres a day with one of these hand dusters. Where the crop is sown in rows the dust may be applied directly to the plants with a hand duster equipped with the ordinary nozzle.

Calcium arsenate and land plaster or gypsum mixed at the rate of 1 part of the arsenical to 15 parts land plaster are also a useful dust. This dust can be applied with a burlap sack or from a can the bottom of which has been perforated with small holes, the operation consisting simply of shaking the sack or can over the plants. The plants should be kept fairly well covered with the dust from the time they appear above ground until danger of insect attack is past.

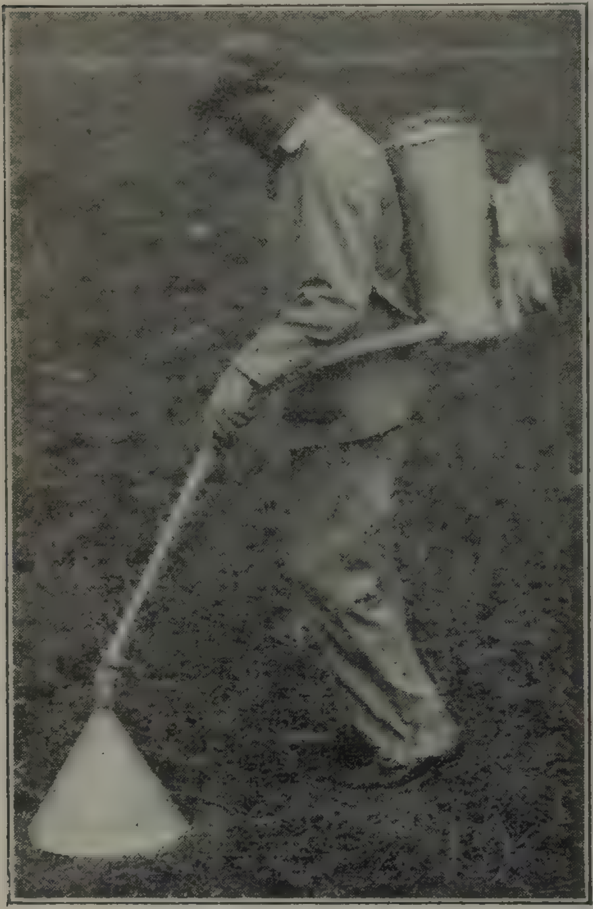

FIG. 10.—Applying nicotine dust to cucumber hills by means of a dusting apparatus with a funnel attachment

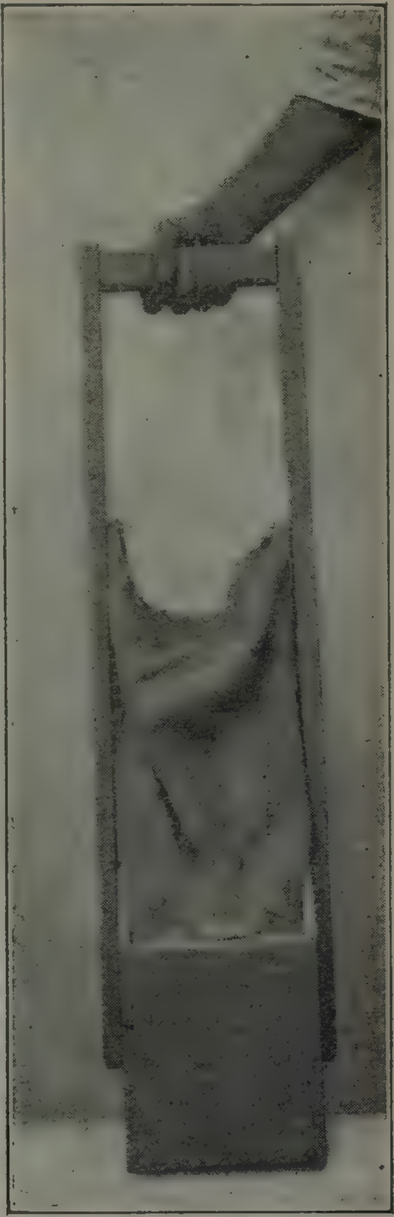

FIG. 11.—Box duster for applying nicotine dust for control of striped cucumber beetles

MELON APHIS

Cucumbers are frequently attacked by the melon aphis, a small louselike insect which obtains its food by sucking the plant juices. It feeds mostly on the underside of the leaves and when abundant causes the leaves to curl, lose color, and finally die. These insects start in the early part of the season as small colonies on the underside of the leaves, and unless checked they soon spread over the entire field. They also are carriers of certain diseases from one plant to another.

Dusting the plants with 2 per cent nicotine dust is perhaps the most effective method of controlling this pest. For best results the dust should be applied at the rate of 30 to 50 pounds per acre when there is no wind, when the air temperature is above 70° F., and when the plants are dry. Hand dusters may be used for applying the dust to small areas and before the lice have spread to all parts of the field, but where the infestation has become general and the infested areas are large, power or traction dusters should be used. Direct the dust to the under side of the leaves.

Spraying with nicotine sulphate to control the lice on cucumber plants has been found effective, but it is more difficult to reach the under side of the leaves with a spray than with a dust. (Fig. 12.) The spray solution is made as follows:[3]

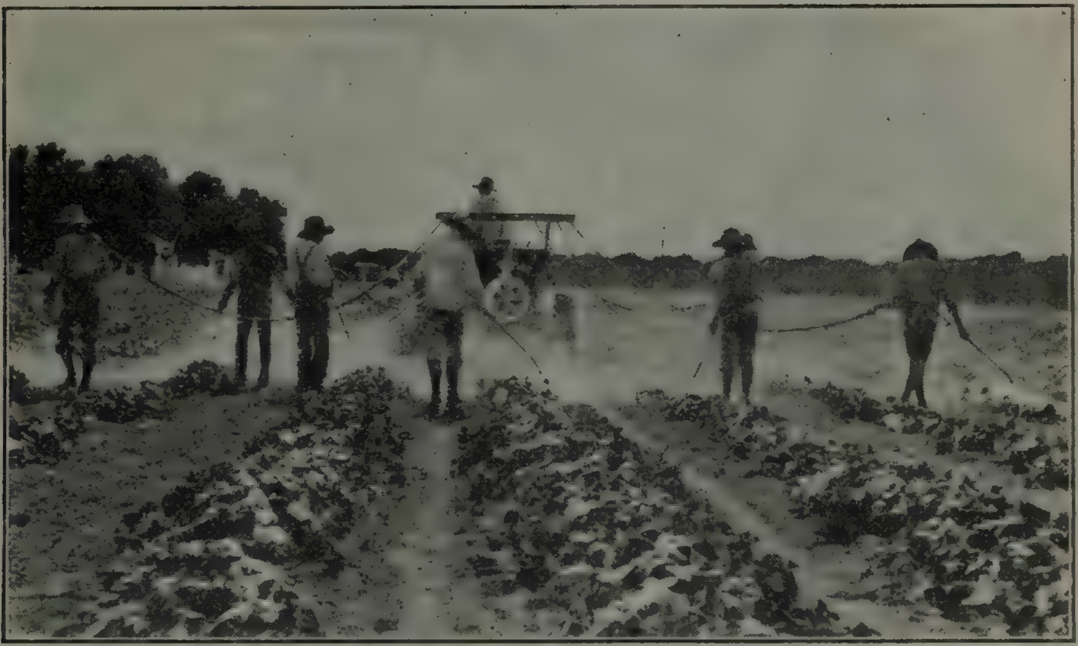

FIG. 12.—Seven rows in a Florida cucumber field being thoroughly sprayed at one time with a power sprayer

Nicotine sulphate (40 per cent nicotine)	⅜ pint.
Soap (laundry or fish-oil soap)	2 to 4 pounds.
Water	50 gallons.

For small quantities make as follows:

Nicotine sulphate (40 per cent nicotine)	1 teaspoonful.
Soap (laundry or fish-oil soap)	1 ounce.
Water	1 gallon.

DISEASES[4]

Cucumbers are subject to a number of diseases that may be avoided by planting on clean land, or the losses caused by them may be reduced by seed treatment, spraying, or other means. Bacterial wilt, mosaic, angular leaf spot, downy mildew, anthracnose, scab, and root knot are fairly common and sometimes serious diseases which the grower should learn to recognize and control. In the Northern States the most important cucumber diseases are bacterial wilt, mosaic, and anthracnose, with scab added in certain localities and in moist cool seasons. Under southern conditions downy mildew, angular leaf spot, and root knot, together with bacterial wilt, are generally most common and severe.

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[3] For further information on the control of insects injurious to the cucumber crop, write to the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C.

[4] Prepared by W. W. Gilbert, pathologist, Office of Vegetable and Forage Diseases, Bureau of Plant Industry.

Cucumbers should not be planted in or adjacent to land where diseased cucumber, muskmelon, or watermelon crops were grown the previous year, because the causal organisms of several of these diseases live over winter in the soil.

BACTERIAL WILT

Cucumbers as well as muskmelons often wilt suddenly and die without any visible reason. The bacterial wilt disease is generally the cause. The bacteria enter and clog the water vessels of the stem and roots, causing wilting. Death of the plant soon follows, and sometimes serious losses result. The bacteria do not live in the soil, but are carried over winter and spread in the field by insects, particularly the striped and 12-spotted cucumber beetles. The best method for the prevention of damage from wilt is spraying with 4–4–50 Bordeaux mixture and calcium arsenate or dusting with gypsum and calcium arsenate, already described in connection with the control of beetles. The pulling and burying or burning of wilted plants is also helpful early in the season.

MOSAIC

Mosaic or "white pickle" occurs on cucumbers in many localities throughout the country, frequently causing heavy losses. It is characterized by dwarfing of the plants, mottling, yellowing, and wrinkling of the leaves, and warting, curling, and mottling of the fruits. Juice from affected plants produces the disease in healthy ones when inoculated into them by any agent. Mosaic attacks several wild plants or weeds, including the wild or bur cucumber, pokeweed, milkweed, ground cherry, and catnip. It overwinters in their roots or seed and is carried to cultivated crops in the spring by insects. Cucumber beetles and lice are the principal agents in carrying mosaic from wild hosts to the cucumber plants and of spreading it in the field. Where cucumbers are grown for pickling purposes, the pickers are also very important agents in spreading mosaic during the picking season. The thorough eradication of the wild host plants in and near the fields, combined with rigid insect-control measures, has proved very successful in controlling mosaic.

ANGULAR LEAF SPOT, DOWNY MILDEW, AND ANTHRACNOSE

Angular leaf spot, downy mildew, and anthracnose all cause their principal visible injury to the leaves, developing and spreading rapidly during moist, warm weather.

Angular leaf spot, a bacterial disease, is carried over winter on the seed and in the soil. It is recognized by small angular water-soaked or tan-colored spots on the leaves. Seed treatment for five minutes in a 1-to-1,000 mercuric-chloride solution followed by thorough washing in water is an effective remedy when combined with crop rotation to avoid infection from the soil. Spraying with 4–4–50 Bordeaux mixture will also help to control the disease.

Downy mildew, also due to a fungus, causes faint yellow spotting and rapid curling and dying of the leaves. Spraying the cucumber vines with 4–4–50 Bordeaux mixture is the best available method of control for the trouble and will materially check the development of all three diseases, often permitting the harvesting of a profitable crop.

Anthracnose, caused by a fungus, produces light brown roundish spots, one-fourth to one-half inch in diameter, on the leaves and elongated sunken lesions on the stems. The best method of control is the same as that for angular leaf spot.

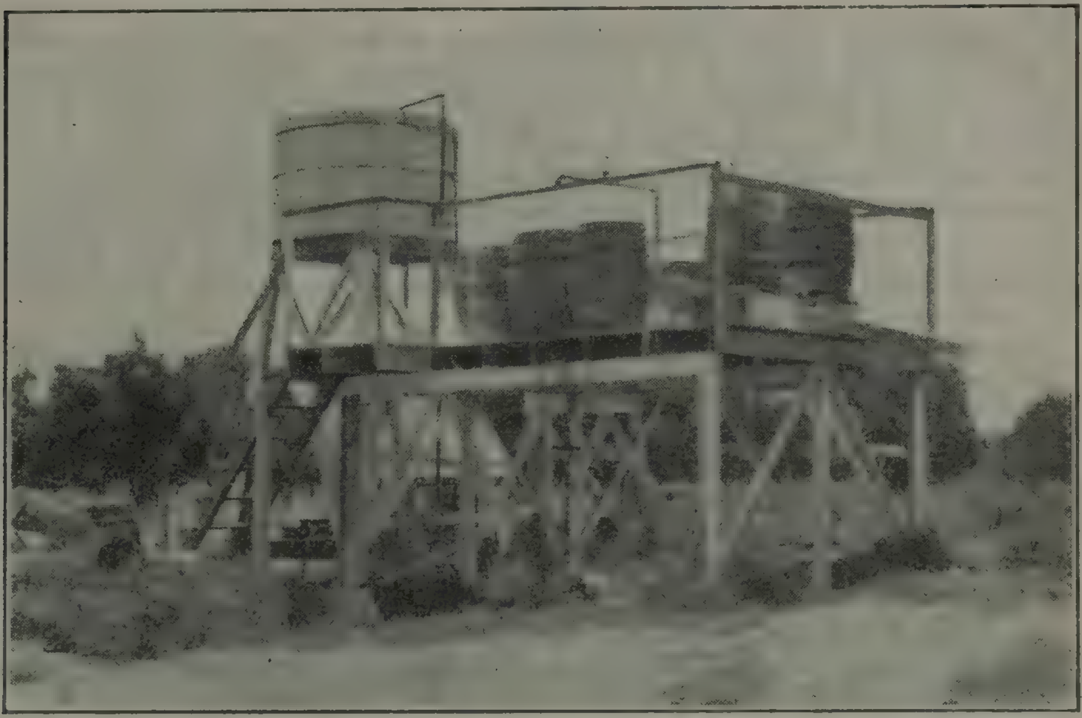

FIG. 13.—Spray-mixing platform of a type used by the Florida cucumber growers. Water for making the spray is pumped from a well to the tank by a gasoline engine located beneath the tank

BORDEAUX SPRAYING FOR CONTROL OF LEAF DISEASES

Spraying with Bordeaux mixture is a preventive rather than a cure for fungous and bacterial leaf diseases. Successful control is obtained only when the work is started early in the season before the diseases become established and when it is done carefully and thoroughly with a high-pressure pump so that all parts of the plants are coated with a fine mist of the spray mixture. It is essential also that the Bordeaux mixture should be properly made and applied at intervals sufficiently frequent to cover the new growth promptly. A power sprayer being operated in a Florida cucumber field is shown in Figure 12.

Where considerable acreage is involved, a power outfit for spraying should be used and a Bordeaux mixing platform constructed. A convenient method is to erect a wooden platform large enough to hold at least 6 to 8 barrels and high enough to permit the solutions to run by gravity from the mixing barrels into the sprayer tank, as shown in Figure 13. It should also be near an ample supply of water.

Stock solutions of copper sulphate (bluestone) and lime should be made in separate barrels, the usual strength being 1 pound to the gallon. To make up 100 gallons of 4–4–50 Bordeaux mixture, place 8 gallons of bluestone stock solution in a 50-gallon barrel and fill it with water. Likewise, after thorough stirring, place 8 gallons of lime stock solution in a second 50-gallon barrel and fill with water, and by means of pieces of hose connecting the bottoms of the barrels allow the two solutions to run together through an 18-mesh copper-wire strainer into the spray tank. Thorough mixing of the two dilute solutions gives the best Bordeaux mixture. It should be used immediately, as it deteriorates with age.

A simplified method of making Bordeaux mixture is being used to a considerable extent, apparently with good results, and it appeals to many growers because of the fact that no mixing platform is required and only enough barrels to hold the stock solution have to be provided, unless water storage is necessary. By this method of making 100 gallons of 4–4–50 Bordeaux mixture, 8 gallons of stock solution of lime (or 12 pounds of hydrated lime) is put directly into the sprayer tank, which is then filled three-quarters full with water and the agitator run to mix it thoroughly. Then 8 gallons of copper-sulphate stock solution is added, and the tank filled with water.

In some instances a weaker Bordeaux mixture (2–4–50) is recommended, particularly in localities where vine injury has resulted from the stronger solution.

The first spray application should be made when the plants are small, before or just as soon as the very first signs of disease appear. Other spray applications should follow at intervals of 7 to 10 days in rainy weather and 10 days to 2 weeks in hot dry weather, until the harvest is completed. A similar schedule should be followed if dusting is used.

Dusting with copper-lime fungicidal dusts is being tested, in some instances with good results, but it is still in the experimental stage. Its principal advantage is its quicker and easier application. Its main drawbacks are the greater cost of material and in some instances reduced effectiveness in disease control.

SCAB

Scab is another fungous disease which attacks the cucumber and is quite serious during moist, cool seasons, in certain northern cucumber-growing sections. It is characterized by the presence of small water-soaked spots on leaves, stems, and fruits, on which drops of a milky, gummy material are found early in the morning. Later in the day these dry up, and cavities with a grayish olive lining of fungous spores are formed. Rotate crops to avoid the disease, as the causal fungus lives over in the soil of affected fields. Also avoid too thick planting.

ROOT KNOT

Root knot is caused by minute nematodes or eelworms which attack the roots of cucumbers and many other farm crops and produce swellings or galls. Dwarfing and death of the plants result, and yields are often much reduced. This trouble is frequently very serious in the sandy soils of the South, but is rarely of importance in the North. Crop rotation and planting of cucumbers only on land free from nematodes are the best methods of control now known.

CULTIVATION OF THE FIELD CROP

Cucumbers should be cultivated from the time the plants break through the ground, keeping the soil loose, mellow, and free from weeds until the spread of the vines makes further working impracticable. At first the cultivation may be fairly close to the hills and reasonably deep, but later after the roots begin to spread the cultivators should be run farther from the plants. It should be borne in mind that normally a cucumber is a comparatively shallow-rooted plant and that the roots often extend beyond the tips of the vines. It is therefore essential that after the vines begin to run freely cultivation should be relatively shallow and not too near the hills. Where the hills are carefully checked, cultivation can be carried on in both directions during the early part of the season. Weeders, one-horse cultivators, and riding cultivators are employed for working the crop. The vines are frequently turned back and the soil cultivated to a depth of about 2 inches even after the vines have made considerable growth. Hand-hoeing will be necessary early in the season while the plants are small. The thinning of the plants in the hills is usually performed during the first and second hoeings. Light side dressings of nitrate of soda and of high-grade complete fertilizers are often applied just ahead of the third hand-hoeing and again during the final cultivation, the fertilizer being broadcast along the rows and worked into the soil by the cultivator.

After the vines cover the ground no further cultivation can be given, but it is sometimes necessary to go through and pull out weeds that are gaining a foothold. The vines of about every seventh row are usually turned back to form a space through which the sprayer can be driven. These spaces later may be used as roads when it comes to gathering the crop. In turning the vines a stick somewhat like an ordinary hoe handle is used.

IRRIGATION OF THE FIELD CROP

Cucumbers are grown under irrigation in the western irrigated districts, but the greater part of the commercial crop of the Eastern and Southern States is produced without irrigation. There are times, however, throughout the region of natural rainfall when irrigation would prove a decided advantage and greatly prolong the picking season. During periods of drought, when the field-grown cucumber crop is suffering because of lack of moisture and prices of good stock are high, irrigation will frequently pay. Many growers are now planting at least a part of their acreage either under overhead irrigation or on land that is subirrigated. Although the question of cost is the determining factor, the tendency is more and more toward the provision of all necessary conditions for making a high-grade crop. The results obtained by the sash-cucumber growers are due largely to their ability to control moisture conditions, thus prolonging the picking season and at the same time keeping up the quality. Being shallow-rooted, the cucumber suffers readily either from the lack of moisture in the soil or from an excess of it. Overwatering should be avoided; short but rather frequent applications of water should be made. It naturally follows that the grower who has irrigation facilities will reap the benefits during the seasons of short crops and high prices.

GATHERING AND PACKING

Table cucumbers must be fresh and crisp when received by the consumer, and the trade prefers that they be of medium size, well formed, and of a dark-green color over at least two-thirds of their length. Too much stress can not be placed upon the necessity for frequent gathering of the cucumbers and their prompt handling after they are gathered. Careful handling is also essential in order to avoid bruising. Cucumbers that are gathered after a rain or in the morning while the dew is on them are liable to be dirty and discolored. All sand or dirt should be either washed or brushed from the surface. Rubbing with a cloth to remove dirt is objectionable, as it removes the small spines and the frosty finish of the fresh cucumbers. The best method of washing cucumbers is to dump the field baskets into a deep tank of clean, cold water through which a fresh stream of water is kept running. Slight stirring of the cucumbers in the tank will usually remove all dirt, but in extreme cases soft brushes are used.

Sash-grown cucumbers are generally gathered every other day, the individual cucumbers being cut from the vines, placed in baskets, and carried or hauled on a low-wheeled wagon or on a small truck to the packing house, where they are washed in a tank of clean, cold water and then spread on a slatted table to drain.

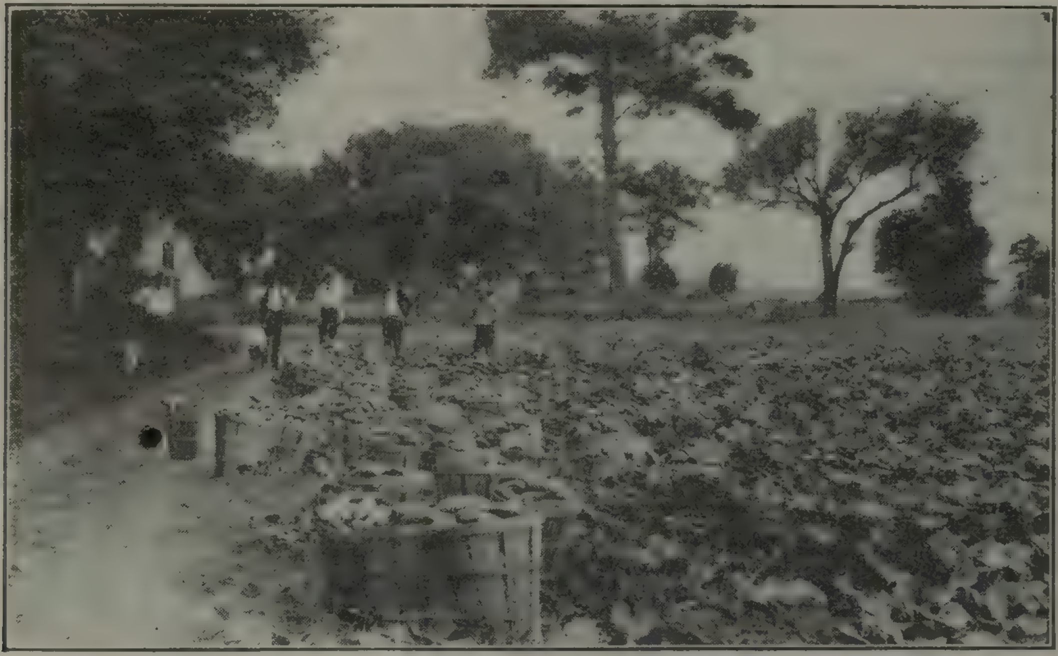

FIG. 14.—Cucumbers gathered in baskets and carried to the ends of the rows. (Photographed near Meggetts, S. C.)

The cucumbers are graded into "fancy," "choice," and "culls." The first two grades are then packed carefully in 28-quart hampers, the cucumbers being laid flat and the top of the hamper faced.

The sash growers in the Norfolk section grade and pack according to rules adopted by the Norfolk Hothouse Growers' Association and have the pack inspected. An attractive cardboard cover which bears the association label and trade-mark is placed on top of the cucumbers beneath the lid. The grower's number and the grade is stamped upon each package.

Shipments of the sash-grown cucumbers are made mainly in refrigerator cars, about 600 hampers constituting a carload. Only the fancy and choice are shipped; the culls are sold locally.

Field-grown cucumbers are gathered as often as necessary to prevent their becoming too large or overripe. During the height of the season this will require going over the vines every day; in fact, the gathering of the cucumbers becomes practically a continuous process.

As the cucumbers are cut or clipped from the vines they are usually placed directly in hampers or in field baskets, in which they are transported either to the ends of the rows (fig. 14), where they are repacked, or to the packing house. The cucumbers are sometimes gathered in bags slung over the shoulders of the workers, but bags are not so satisfactory for handling the cucumbers in the field as are the 1-bushel baskets or hampers. Splint baskets and rough crates should not be used for gathering the crop, on account of injury to the tender surface of the cucumbers.

A stick with a crosspiece about 1 foot in length nailed to its end is frequently used for turning the vines to locate the cucumbers; it has the double advantage of saving the operator from excessive stooping and serving as a protection against poisonous snakes in localities where they are found.

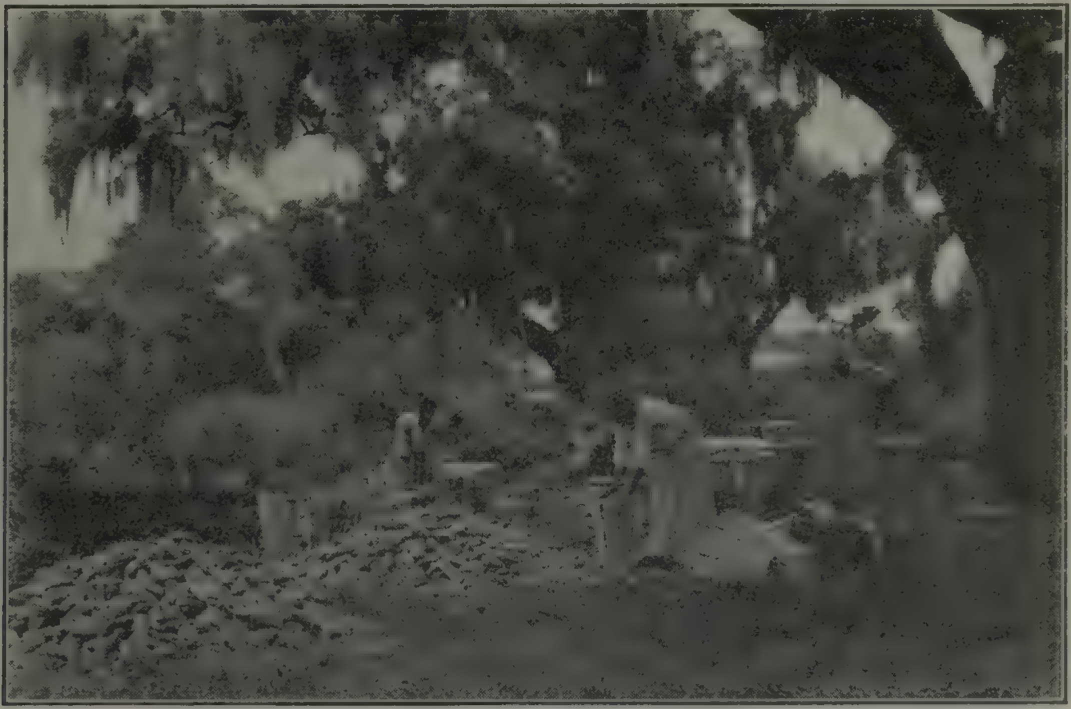

FIG. 15.—Packing cucumbers for the market under the shade of a giant live oak near Meggetts, S. C.

In most sections field-grown cucumbers are packed in the field, being graded either as they are gathered from the vines or more often at the ends of the rows or at a temporary packing shed located in the field. In some instances they are hauled to the shelter of a large tree (fig. 15) where the grading and packing are done. In a few cases the cucumbers are hauled to a centralized packing shed where they are washed, graded, and packed in a careful manner. Belt graders are sometimes used in the centralized packing house, but as a rule the cucumbers are simply graded by hand over tables and are packed directly into the hampers. For low cost of handling, however, packing in the field is considered most desirable, although a better grade and pack can be secured in a central packing house.

The United States standard grades for slicing cucumbers as established by the Bureau of Agricultural Economics[5] are now used by many individual growers and growers' associations. These rules are modified or amended from time to time to suit changed conditions.

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[5] U. S. DEPARTMENT OF AGRICULTURE, BUREAU OF AGRICULTURAL ECONOMICS. UNITED STATES STANDARDS FOR SLICING CUCUMBERS (1927). 2 p. 1927. [Mimeographed.]

LOADING AND SHIPPING

Field-packed cucumbers are generally hauled to the shipping point and loaded directly into the cars. Where the packing is done in a central packing shed, located on a railroad siding, the hampers of cucumbers are loaded directly into cars as they are packed. In any event, the packages should be removed from the field as quickly as possible after packing, to avoid exposure of their contents to sun and wind. Where the pickers do the grading it is customary to have one man follow behind each gang of pickers to fasten the lids upon the hampers and mark the grade upon each package with a rubber stamp. To facilitate these operations the nails, hatchet, stamp, and ink pad are carried in a tray having a convenient handle. As a rule the lids are distributed by a boy ahead of the man who does the "lidding." The truck or wagon for hauling follows closely behind and loads the hampers within a short time after they are packed. When once upon the wagon or truck the cucumbers can be protected from the sun and wind by a canvas cover. Usually the distance to the loading point is short, making it unnecessary to cover the load during the trip; but where the crop is hauled direct from the field to market by truck it is essential that the load be well protected by such a cover.

Certain definite rules as laid down by the carriers are observed in loading the hampers of cucumbers in the cars. The main essential for good loading is that the hampers be so placed that they can not shift in transit. The method of shipment, whether under refrigeration or merely under ventilation, will depend upon the time of the year and the distance to market. As a rule, when the weather is reasonably cool and the shipment will reach the market within 36 hours it is not necessary to ship under refrigeration, but during warm periods and for long hauls shipment in refrigerator cars with bunker icing is essential. Where the cucumbers are sold f. o. b. shipping point, the question of method of shipment is left to the buyer, but where the goods are consigned or sold on delivery the method of shipping should conform to the wishes of the commission house or buyer receiving them.

SUMMARY

Cucumbers are one of the 20 important truck crops in the United States, although not one of the most important. Fair returns are obtained from the growing of cucumbers where all of the requirements for their production and handling are properly met.

The intensive production of cucumbers under sash, especially in the Norfolk, Va., section, is fairly profitable, especially to growers who are giving the work close attention.

The consumption outlook for cucumbers in the United States would not warrant any material increase in the acreage planted to cucumbers for table use. To prove satisfactory, cucumbers must reach the consumer in a fresh, crisp, and palatable condition.

Cucumbers should be shipped packed for the market according to the United States standard grades and under refrigeration wherever conditions require it in transit.

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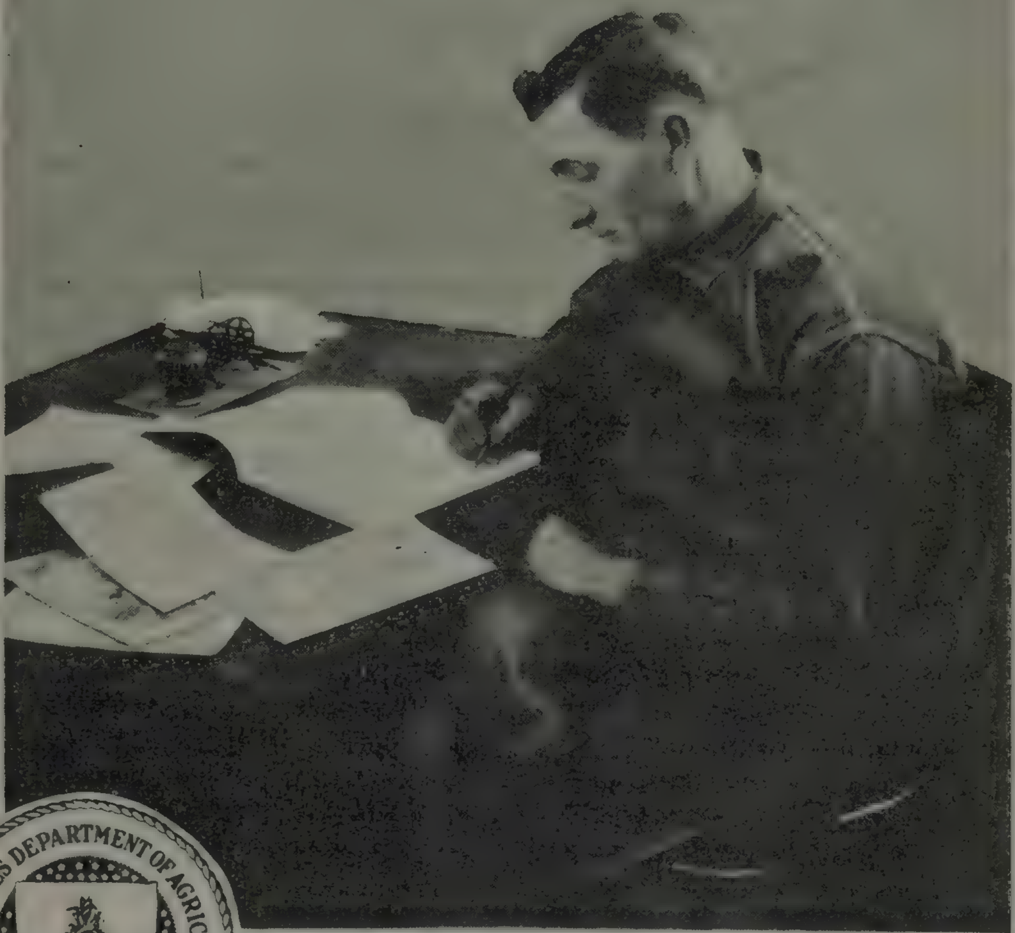
U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1564

FARM BUDGETING



THE FARMING INDUSTRY of the United States loses many hundred millions of dollars each year because production is overexpanded along some lines and underexpanded along others. These ups and downs in agricultural production are partly the result of changes made by farmers in acreages of crops and numbers of livestock. Changes of this kind are necessary and unavoidable, but too often they are overdone in some lines and underdone in others. Decisions as to these changes are often based upon the prices at or immediately before planting or breeding time and upon the crop yields and livestock production of the preceding season. The adaptation and application of the budget method, used in other business undertakings, is suggested as one way for farmers who act independently to meet the situation.

A farm budget is a carefully worked-out plan based on estimates as to how well a particular combination of crops or combination of crops and livestock will pay. These estimates are based upon the available information as to what the prices and crop and livestock production are likely to be during the year or period of years just ahead. Although prices, crop yields, and livestock production can not be forecast exactly, they can be foretold within broad enough limits to make it profitable to organize carefully and to focus attention upon the best available information relating to them. A method of doing this is outlined in this bulletin.

First, the method of procedure in making a budget is described. Next, the use of budgets in deciding upon the crops and livestock for the coming year and in keeping a profitable system of farming in mind is described. Finally, the information needed is mentioned, some of the sources of this information are listed, and forms to be used in making a budget are shown.

Washington, D. C. **Issued July, 1928**

FARM BUDGETING

By J. B. HUTSON, *Agricultural Economist, Division of Farm Management and Costs, Bureau of Agricultural Economics*

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WHAT IS A BUDGET?

THE WORD BUDGET usually means a plan for future using or spending. In farming, a budget means a plan for the future use of the land, man labor, horse work, equipment, and other resources that the farmer has to work with. It includes the plan for the system of farming for the coming year, or for a period of years. It shows the crops to be grown, the livestock to be kept, and the estimated production, receipts, and expenses from the various sources. The budget is the businesslike way to work out and record farm plans. An illustration of a budget for a 180-acre farm in western Kentucky is shown in Table 1.

HOW A FARM BUDGET IS MADE

A budget for the coming year is made on the basis of the prices, crops and livestock requirements, and production expected for the year. The method of procedure to be followed in making a budget will vary with the system of farming being considered. The budget should show, in the simplest way possible, the expected crop and livestock production, the expenses, and the receipts for the particular system contemplated. The budget in Table 1 is suggested for a diversified crop and livestock system of farming.

First, the acreages of the different crops contemplated and the crop expenses that appear probable should be recorded. (See section A of the budget on page 2.[1]) The next step is to estimate the production of the different crops and how much will be needed for seed, how much will be fed to livestock, and how much will be sold. (See section B.) Then the number and kind of livestock to be kept should be indicated. Next the feed requirements and other expenses for the livestock should be recorded. (See section C.) Often it will be advisable to divide this section into two parts, one showing how the feeds on hand at the beginning of the year are to be used and the other showing the feed crops to be consumed by the livestock from the harvest season to the end of the year.

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[1] The budget shown here is for the year 1927 and was worked out in cooperation with the operator of the farm in March, 1927. Available data as to the prices that had prevailed in the area during the past few years were analyzed, and a careful study was made of conditions likely to influence prices during the years just ahead. The prices of products to be sold and expense items used in working out this budget are shown in Table 3, page 17. Farm-accounting work had been done in the area during the three previous years, and these data had been carefully analyzed. The results obtained on two subexperiment-station fields located in the same type-of-farming area and livestock experimental data applicable to conditions in the area were reviewed. The crop yields and requirements used in working out the budget are shown in Table 4, page 17. The livestock production and requirements used are shown in Table 5, page 18.

TABLE 1.—*Budget for 180-acre farm in western Kentucky*

SECTION A—ACREAGE AND CASH EXPENSES FOR CROPS

Crops	Acreage	Seeds and plants		Other expenses		
		Quantity	Cost	Kind	Quantity	Cost
		Bushels	*Dollars*			*Dollars*
Corn	30	3				
Tobacco	8			Superphosphate (acid phosphate). Canvas Arsenate of lead	2,400 pounds 80 yards 40 pounds	26.40 4.00 10.00
Wheat	20	25		Superphosphate (acid phosphate). Twine Threshing	4,000 pounds 40 pounds 280 bushels	44.00 4.80 33.60
Soy-bean hay	5	3¾				
Soy-bean seed	5	3¾				
Mixed hay	30	(1)	96.30			
Total			96.30			122.80

SECTION B—PRODUCTION AND DISPOSAL OF CROPS

Crops		Production (quantity)	Disposal			
			Feed (quantity)	Seed (quantity)	Sales	
					Quantity	Value
						Dollars
Corn	bushels	840	793	3	44	30.80
Tobacco	pounds	8,000			8,000	720.00
Wheat	bushels	280		25	255	344.25
Soy-bean hay	tons	6¼	[illegible]		¼	4.00
Soy-bean seed	bushels	75		7½	67½	135.00
Mixed hay	tons	30	18		12	192.00
Total						1,426.05

SECTION C—FEEDS AND OTHER EXPENSES FOR LIVESTOCK

Livestock	Number	Home-grown feeds		Purchased feeds			Other expenses	
		Kind	Quantity	Kind	Quantity	Cost	Kind	Cost
					Pounds	*Dollars*		*Dollars*
Cows	6	Corn Soy-bean hay. Mixed hay	84 bushels 6 tons do	Bran Cottonseed meal.	1,500 1,500	26.25 28.50	Breeding fees Miscellaneous	15.00 6.00
Young heifers	4	do	2 tons					
Veal calves	3	Whole milk	1,500 pounds					
Sows with pigs	3	Corn	384 bushels	Tankage	1,500	52.50	Breeding fees Miscellaneous	10.00 2.00
Poultry	100	do Skim milk	100 bushels 1,032 pounds[2]	Meat scraps Oyster shells	500 500	20.00 6.25	do	2.00
Work horses	5	Corn Mixed hay	225 bushels 10 tons				Shoeing Miscellaneous	15.00 5.00
Total		Corn Mixed hay	793 bushels 18 tons			133.50		55.00

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[1] Includes 150 pounds red-clover seed at 27 cents; 150 pounds orchard-grass seed at 14 cents; 90 pounds alsike-clover seed at 22 cents; and 60 pounds redtop seed at 25 cents.

[2] Taken from whole milk used in the home.

TABLE 1.—*Budget for 180-acre farm in western Kentucky*—Continued

SECTION D—PRODUCTION AND DISPOSAL OF LIVESTOCK AND LIVESTOCK PRODUCTS

Livestock and products		Production (quantity)	Disposal			
			Fed to livestock (quantity)	Used in home (quantity)	Sales	
					Quantity	Value
						Dollars
Whole milk	pounds	30,000	1,500	3,500	25,000	535.50
Veal	do	480			480	38.40
Pork	do	4,800		800	4,000	340.00
Old hens	do	200			200	36.00
Young poultry	do	150		100	50	11.00
Eggs	dozen	900		[3] 170	730	146.00
Total						1,106.90

SECTION E—SUMMARY OF RECEIPTS AND EXPENSES

Receipts	Total value	Expenses	Total value
	Dollars		*Dollars*
Crops (sec. B)	1,426.05	Crops (sec. A):	
Livestock and livestock products (sec. D)	1,106.90	Seed	96.30
		Other crop expenses	122.80
		Livestock (sec. C):	
		Feed purchased	133.50
		Other livestock expenses	55.00
		Other expenses (estimated):	
		Hired labor (threshing)	25.00
		Machinery (new and upkeep)	60.00
		Fence (new and upkeep)	30.00
		Buildings (repair)	100.00
		Taxes, insurance, and other overhead	125.00
Total	2,532.95	Total	747.60
Net returns	1,785.35		

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[3] Includes 20 dozen eggs used for hatching.

At this point it will usually be advisable to compare the data showing the feeds on hand at the beginning of the year and crops to be grown for feed, with data showing the expected feed requirements. Generally, before a cropping program and livestock program are finally decided upon, adjustments will need to be made in first one and then the other until a livestock program adapted to a particular cropping program is found. When the kind and numbers of livestock contemplated have been recorded, the quantities of the livestock and livestock products expected to be used in the home and to be sold should be indicated. (See section D.)

The expected value of the crop and livestock products to be sold and the expected cost of the purchased feeds, seeds, fertilizers, and other materials should then be indicated. (See cost and value columns of sections A, B, C, and D.) Next, these expected expenses and receipts should be brought together. (See section E.) In addition to the direct costs for crops and livestock, estimates should be included on the expense side for labor, new machinery and repair, new fences and fence repair, building repair, taxes, farm insurance, and other overhead items.

WHY A FARM BUDGET?

The purpose of working out farm budgets is to aid in determining in advance the returns that may reasonably be expected from the different systems of farming that may be followed, or the results that may reasonably be expected if changes are made in a particular one. Generally larger profits will result if plans for the system including probable expenses and receipts are carefully developed and compared with plans for other possible systems before the one chosen is actually put into operation. In this way many costly errors may be avoided. Specifically, the use of farm budgets carefully worked out has the following advantages:

Budgets help farmers more accurately to appraise different systems and practices so that the most profitable systems and practices may be decided upon. They offer a definite basis for comparisons between systems made up of different combinations of crop and livestock.

Budgets help to keep a good balance between crops in a crop system of farming and a good balance between crops and livestock in a crop and livestock system.

Budgets help to determine in advance how much seed, fertilizer, and other supplies are likely to be needed during the year.

Budgets help to determine how much feed will be needed for the livestock, how much will need to be bought, and how much is likely to be available for sale.

Budgets help in determining the amount of cash that will be needed to operate the farm, and when it will be needed, so that the necessary financial arrangements may be made.

Budgets help in determining the total net returns that may be expected so that living expenses, payments, or investments may be adjusted accordingly.

Stated more generally, budgets are advised because conditions affecting farm returns are continually changing. These changes are reflected in prices, crop yields, livestock production, and crop and livestock requirements.

Two kinds of price changes are of particular significance to farmers. First, there are price trends or long-time upward or downward movements of prices. These long-time upward or downward movements are usually different for different products. For example, in South Dakota for the five-year period 1921 to 1925, corn increased in price over the five-year period from 1911 to 1915, 8 per cent, wheat increased 20 per cent, potatoes 18 per cent, hogs 18 per cent, and beef cattle 5 per cent, whereas the price of barley decreased 20 per cent and that of oats decreased 14 per cent. In western Kentucky the price of dark tobacco, the principal product of the section, has been little, if any, higher during recent years than during pre-war years, whereas the prices of most other farm products of the section have been considerably higher during recent than during pre-war years. Similar price changes are continually taking place in most farming sections both for products sold and for expense items.

Other price changes of interest to farmers are price cycles. The prices of many farm products tend to move upward for a period of years and then downward for a more or less similar length of time. For example, hog prices usually tend upward from one and one-half to two and one-half years and then downward for about the same length of time. For most other species of livestock the upward and downward movements are for longer periods. There appears to be a tendency for beef-cattle prices to go up from six to nine years and then down for a somewhat similar length of time. In the case of horses the upward and downward price movements tend to extend over periods of 10 to 15 years. The most important factor in determining the length of these upward and downward movements is the length of time required to expand or contract materially any enterprise after unusually high or unusually low prices are reached.

Price trends and cycles are due to developments that are worldwide in scope. Changes in the habits and tastes of people, in channels of trade, and in transportation costs and the opening up of new production areas all play their part in causing price trends. The adjustments in production plans that farmers make in response to prices are largely the cause of price cycles.

In addition to price trends and cycles the amounts of crops and livestock held over from one year to the next vary and have an influence on the prices of the following year. The amounts of different products that will be taken at given prices vary with industrial activity and related factors. As a result of these and other factors, farmers are continually facing new price situations.

On the production side new practices are developed for cultivating and harvesting crops and for feeding livestock, and these new practices result in different man labor, horse work, feed, and other requirements. The wheat binder, the corn binder, the tractor, the small combine, each has had or is having its influence on the amounts of labor needed in growing particular crops and on the net returns obtained. Crop yields are continually being affected by insect and crop pests. For example, the boll weevil has been responsible for a reduced yield of cotton and has made it desirable to consider changes on most farms in the Cotton Belt. Now the corn borer promises a similar problem for the Corn-Belt farmer. Livestock are not without their diseases and parasites.

Many of these changes are more or less permanent in nature and may be known. Other developments may be anticipated with some degree of accuracy. Obviously such things make changes advisable in the crops to be grown and the livestock to be kept on a particular farm. The crops and livestock that will result in the largest returns at one time will not always give good results at some later time.

In their efforts to cope with these changed or new situations farmers are continually making adjustments in crops, livestock, and practices. Usually these adjustments are the result of comparisons of the returns expected from different systems and practices. Some of these comparisons are simple and easily made and some are complex and involved. Some of them are crudely and imperfectly made and others are carefully worked out.

These comparisons are often based upon facts taken from memory, and are made without the use of pencil or paper. Sound conclusions may be reached in this way in the case of simple comparisons, but most problems in present-day agriculture are too involved to make this method advisable. In highly commercialized farming, usually, a change in one enterprise makes changes desirable in several other enterprises. Then there is the ever-present tendency to give too much weight to the prices, the yields, and the production that result from conditions more or less temporary in nature, and this tendency is likely to be more pronounced when the memory alone is depended upon. Generally, safer conclusions will be reached and larger profits will result from the farming operations if the facts considered are carefully organized and if judgments are completely formed and recorded and if the comparisons between enterprises and systems are carefully worked out. This involves the use of farm budgets.

WHEN TO MAKE FARM BUDGETS

December, January, and February are the budget-making months in most parts of the country, and in some sections March is used. These are the months when a farmer usually has the most time to do uninterrupted thinking. When the crops are harvested a farmer can usually find time to take stock, review the successes and failures of the past season, compare the results actually obtained with those expected at the beginning of the year, and make a budget for the coming year.

HOW TO USE THE BUDGET METHOD IN MAKING FARM PLANS

As suggested above, an important use of farm budgets is in reaching conclusions as to crops and livestock that are likely to prove most profitable under given conditions. In this connection it should be kept in mind that farming is a forward-looking undertaking and that plans should be made on the basis of conditions expected in the future. One should be as familiar as possible with the results of the past. However, the results of the past should be interpreted in the light of conditions expected in the future. This is what is attempted in making farm budgets.

One use of farm budgets is in finding the crops and livestock—the acres of each crop and the number of each kind of livestock—that will probably result in the largest returns during the coming year. Another use is in finding the crops and livestock that will probably result in the largest returns over a period of years. The former is usually considered the plan for the coming year and the latter the long-time plan or the system of farming.

MAKING PLANS FOR THE COMING YEAR

The kinds of crops and livestock should usually remain the same for a period of years, but it is seldom possible or advisable to plan to grow the same acreage of each crop or keep the same number of each class of livestock each year. If nothing else, variations in the number of livestock born, and crop failures of the previous year, will make this impossible in some cases and inadvisable in others. Then there are lines of production, like dairying or handling a breeding herd of beef cattle, that a farmer must grow into; they can not well be developed in a year. Furthermore, if a farmer makes a study of the conditions that influence prices he will usually be able to form more accurate judgments as to prices expected during the coming year for at least some of the products than those of the past year or even the average for a period of years. It follows that the plans for each year should be different, in at least some respects, from the plans for any other year.

A farmer who has definitely in mind a long-time plan should make a budget showing the returns expected and the prices that appear most likely to prevail during the coming year. If he has no long-time plan definitely in mind, perhaps the best starting place is with the crops and livestock of the previous year. In either case the next step is to make comparisons as to the changes in returns that appear probable if increases are made in the acreage of crops and the numbers of livestock for which relatively high prices are expected and decreases in those lines in which relatively low prices are expected.

Many possible alternatives may be eliminated or tentatively decided upon by these simple comparisons. For example, a farmer who is accustomed to growing wheat along with other crops may be considering whether it will be advisable to substitute barley for a part of the wheat. Suppose the cropping program calls for 60 acres of spring wheat, and the farmer is trying to decide whether to substitute barley for 20 acres of the wheat. Granting that the substitutions could be made without affecting other enterprises, he would need only to consider the costs, prices, and yields of these two crops. A method of working out a comparison of this kind follows:

Probable income from wheat:		
255 bushels (20 acres at 14 bushels less 25 bushels seed) at $1.35		$344.25
Threshing 280 bushels at 12 cents	$33.60	
Twine, 40 pounds at 12 cents	4.80	
Fertilizer, 2 tons at $22	44.00	
Total, threshing, twine, and fertilizer		82.40
Net income from wheat		261.85
Probable income from barley:		
445 bushels (20 acres at 24 bushels less 35 bushels seed) at 75 cents		333.75
Threshing 480 bushels at 10 cents	$48.00	
Twine, 45 pounds at 12 cents	5.40	
Fertilizer, 2 tons at $22	44.00	
Total, threshing, twine and fertilizer		97.40
Net income from barley		236.35
Probable excess in favor of wheat		25.50

It will sometimes be advisable to attempt simple comparisons of this kind where three or more enterprises are involved. Usually, however, when changes are being considered that affect more than two enterprises and often when changes for only one or two are contemplated, the problem is too complex for such simple comparisons. Sometimes it may be advisable to consider the substitution of a crop that has different man-labor and horse-work needs or that requires attention at a different time of the year from the crop to be displaced. Such substitutions usually mean either more thorough or less thorough cultivation of other crops. Often changes may be considered that will mean more or less home-grown feed or a different ration for the livestock. In the case of involved changes of these kinds other complete budgets are recommended.

It will sometimes be advisable to work out several trial budgets each indicating the farmer's judgment as to the returns that may reasonably be expected during the coming year from different combinations of crops and livestock. Each of these budgets should carry data similar to those suggested in Table 1, pages 2 and 3.

It is important that each of these budgets be worked out on a similar basis. That is, a farmer should not use the prices, yields, and other production relations of the past years for one budget and then use those expected in the future for other budgets. Since systems of farming are planned for the future, the prices and production relations used should be those that are expected in the future. In some cases it may be advisable to take the feeding requirements and livestock production of the past year and work out a financial statement, using normal crop yields and expected prices. Whenever experience or available data warrant, however, it will be advisable to adjust the livestock data, as well as the yields, to a normal basis.

The budgets worked out in this way should then be compared. After taking into account the amount of risk involved under each, the changes each necessitates in livestock on the farm at the time, the changes from the crops of the past season, and the probable effect of each change on the returns of the following years, one of these budgets should be decided upon as the plan for the coming year. Budgets of this kind should be made at the beginning of each year.

BUDGETS WITH VARYING PRICES AND YIELDS

Even after a plan for the coming year has been carefully worked out, adjustments in this plan may be advisable during the year. Less favorable production may be obtained along some lines than were anticipated, and more favorable production may be obtained along other lines. Higher prices may be obtained for some products than were anticipated and lower prices for others.

In cases in which the prices contemplated for the crops and livestock vary widely from year to year, or in which the information to be used as a basis for judgments as to prices, is meager, it may be advisable to work out different budgets for the crops and livestock decided upon for the year, and to use different prices, each being based upon a particular set of prices within the range of probability. That is, the expenses, receipts, and net returns that will probably result from a given combination of crops and livestock with different prices may be worked out.

In areas in which the yields of crops vary widely from year to year it may be advisable to work out different budgets for the same system, using the different yields which are within the range of probability.

Such budgets, worked out with varying prices and yields, will help a farmer to determine maximum and minimum expectations from his crops and livestock, and to anticipate possible adjustments that may be necessary during the year. For example, crop yields below normal may make it advisable to sell livestock with less finish or at lighter weights, or may make it advisable to reduce the number of one kind of livestock and increase the number of another. Or it may be well to make changes in the feeding plans during the year.

Prices and production can not be forecast with enough accuracy to make it unnecessary to be on the lookout for possible improvements through adjustments of this kind. The more carefully a farmer has thought through these problems in advance the better prepared he will be to meet such conditions as they arise.

PLANNING A SYSTEM OF FARMING

Often prices or conditions on the farm may so change as to make it advisable to reorganize the farm completely and introduce a new system of farming or a system markedly different from the one that has been followed. For example, a farmer may be engaged in dairying; that is, in growing feed crops and selling dairy products, and conditions may be such as to make it advisable to consider feeding beef cattle and hogs. Or a farmer may be engaged in growing cotton along with a small amount of feed for the work stock, and conditions may be such as to make it advisable to consider dairying or some other kind of livestock farming.

In trying to decide whether a marked change of this kind will be advisable in the system of farming that is being followed, a farmer should first look about in his own community, and in other communities that have similar conditions, and consider the results that other farmers are getting from other crops and livestock. A system that has given good results on one farm may not give good results on another farm even in the same community, since no two farms are exactly alike, and may not give good results on the same farm under different conditions, but this general appraisal of other systems is a good preliminary move. From it a farmer should get a general idea of other crops, livestock, and systems that are adapted to his conditions.

It is at this point that the budget plan may again be used to advantage. The use of carefully worked-out budgets is the most accurate way to compare the various systems that may be considered. While the budgets to be used in this connection should be made on the yearly basis, they should be based upon average yields and production requirements and upon the average prices expected during the period of years just ahead. They should show the average of the acres of crops and the numbers of livestock, the estimated production, expenses, and receipts for the period. The period considered should be at least as long as the rotation contemplated. If special buildings or machinery are needed, which is often the case, a 5-year or 10-year period or even a longer period should be considered.

It will be advisable to study available information and to formulate judgments as to prices, crop yields, livestock production, and crop and livestock requirements, as described above, for such crops and livestock as appear to have possibilities on the farm that is being considered. Next, a budget similar to that suggested on pages 2 and 3 should be prepared for the present system. Following this, the farmer should consider desirable combinations of crops and livestock for other systems and work out budgets for them.

In deciding upon the acreage of the different crops and the numbers of the different classes of livestock to include in the systems that are being considered, the seasonal as well as the total man labor and horse-work needs of each crop and class of livestock should be kept in mind. It is generally advisable to consider only such combinations of crops and livestock as can be taken care of by the men and teams that are likely to be available. If systems are to be compared with markedly different man labor and horsework requirements, the cost of providing the added labor must be considered.

The budgets worked out in this way should be compared. In comparing the budgets of the different systems, each should be considered critically for the purpose of determining how well the principal crops are adapted to the area, the effect of each system upon the fertility of the soil, the kinds of markets that are available for each of the products to be sold, how nearly the feed crops provide a balanced ration for the livestock if the system includes livestock, how well the crops and livestock fit together, and how well the nonmarketable products, such as pasture, straw, stover, and skim milk are utilized with each. With these facts, and the returns that may reasonably be expected from each in mind, one of the systems should be selected as the system to be followed. Presumably this will be the system that, other things being equal, promises the largest returns on the basis of normal yields and production requirements and prices expected for a period of years.

It is not usually necessary to make comparisons of this kind, involving other systems of farming, each year. After a system has been decided upon it should be followed until conditions of the period or on the farm have undergone a marked change. A farmer should continually be on the alert, however, for new developments and should consider carefully the possibilities of other systems whenever conditions warrant.

KEEPING ACCOUNTS AGAINST THE BUDGET

After a budget has been made an inventory should be taken, the expenses and receipts should be kept during the year, and at the end of the year the returns actually obtained should be compared with those contemplated in the budget. If a budget has been made for a period of years it may also be included in the comparisons. A method of recording data for these comparisons is shown in Table 2.

Accounts provide material that is essential to a thorough-going analysis of the farm business as it has been operated in the past. They are valuable in helping to locate the strong and weak points of the system being followed. They aid in locating the leaks in the profits. For example, the crop yields and requirements of that year may be compared with those contemplated in the budget and with those obtained by other farmers. The returns for the feed consumed by the livestock may be compared with the returns contemplated in the budget and those obtained by other farmers. Accounts provide a basis for determining how the labor, building, machinery costs, and other expenses compare with those contemplated in the budget and those prevailing on other farms. Attention to such points makes economical production possible.[2]

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[2] For more complete discussion of farm accounts, see the following bulletins:
LADD, C. E. A SYSTEM OF FARM COST ACCOUNTING. U. S. Dept. Agr. Farmers' Bul. 572, 15 p. 1914.
THOMSON, E. H. FARM BOOKKEEPING. U. S. Dept. Agr. Farmers' Bul. 511, 37 p., illus. 1912.
For method of analyzing farm business see: DIXON, H. M., and HAWTHORNE, H. W. A METHOD OF ANALYZING THE FARM BUSINESS. U. S. Dept. Agr. Farmers' Bul. 1139, 40 p., illus. 1920.

TABLE 2.—*Comparison of acres of crops, numbers of livestock contemplated, and expected receipts and expenses for long-time plan, and plan for coming year, with results actually obtained, 180-acre farm*[1]

Item	Last year	Long-time plan	Plan for coming year	Actual results, end of year
Crop:	*Acres*	*Acres*	*Acres*	*Acres*
Corn	30	30	30	----------
Tobacco	11	10	8	----------
Wheat	7	10	20	----------
Soy-bean hay	7	10	5	----------
Soy-bean seed	----------	----------	5	----------
Mixed hay	50	30	30	----------
Pasture	46	51	46	----------
Livestock:	*Number*	*Number*	*Number*	*Number*
Work stock	5	5	5	----------
Cows	2	10	6	----------
Young cattle	2	5	4	----------
Sows	1	3	3	----------
Other hogs	5	24	24	----------
Chickens	45	100	100	----------
Results:	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Farm receipts	1, 840	2, 886	2, 533	----------
Farm expenses	689	864	748	----------
Net returns	1, 151	2, 072	1, 785	----------

[1] The operator of the farm whose returns last year and whose budgets for a period of years and for the coming year as shown above has been depending upon crops as sources of income. He plans in the future to combine some cash crops and dairying. One reason that the plan for the coming year differs from the long-time plan is that the operator considers it advisable to buy only 4 cows during the coming year and grow into dairying.

Accounts, if accurately kept and intelligently interpreted, may become the best source of information in helping to determine the production that may reasonably be expected to result from a particular practice, enterprise, or system of farming. In making farm budgets an opportunity is offered to use these accounting data in connection with experimental data and information on prices in planning future operations. Accounts help a farmer to localize and interpret experimental results in terms of conditions on the farm. This will be discussed further in a later section. Most State colleges of agriculture have account books suitable for recording inventories, expenses, and receipts which they furnish at a small cost. Such books can usually be obtained from the county agent or by writing to the State college of agriculture.

INFORMATION NEEDED IN MAKING A BUDGET

The returns actually obtained in farming probably will not approximate the returns contemplated in a budget unless the prices, requirements, and yields used in making the budget approximate those that actually prevail. Those used in making the budget should represent the best judgment of the one doing the planning, as to the production and prices that may reasonably be expected for the particular farm and period, after considering all the information available. The information available that will be useful may be divided into two classes—that relating to prices and that relating to production.

PRICE INFORMATION TO BE USED

In order to plan for the coming year and at the same time to keep a permanent and profitable system of farming in mind, judgments must be formed as to prices expected for the coming year and for the period of years just ahead.

Average prices, price trends, and long-time demand changes must be known to form judgments as to prices for a period of years. In the case of prices for the coming year, in addition to the above, the facts as to supplies on hand, production in competing areas and countries, and demand changes likely to come about during the year are important. Such information is to be found in market-news reports, agricultural-situation reviews, and in agricultural-outlook statements issued by State and Federal agencies.

SOURCES OF PRICE INFORMATION

The following are the principal sources of information on prices:

Market reports as issued by the Federal market news service and distributed by mail, radio, and through the farm newspapers.

Crops and Markets, the monthly periodical issued by the United States Department of Agriculture.

Special commodity price studies issued by the United States Department of Agriculture and many of the States.

The Agricultural Situation, a monthly publication issued by the United States Department of Agriculture and similar reports issued by several of the State colleges of agriculture and extension services.

Yearbooks of the United States Department of Agriculture; yearbooks of State departments of agriculture and State agricultural statisticians.

Annual agricultural-outlook reports, issued by the United States Department of Agriculture, and outlook reports issued by State colleges of agriculture and extension services in many States.

Statistical bulletins issued by the United States Department of Agriculture.

MARKET NEWS REPORTS

The United States Department of Agriculture market news service and State departments of agriculture review the market situation for the principal farm commodities weekly and monthly during the year. These reviews are distributed by mail, by radio, and in weekly and farm papers. The prices on future-trading markets indicate the judgment of dealers and speculators as to the trends in prices during the months just ahead.

CROPS AND MARKETS

Crops and Markets is the monthly publication of the United States Department of Agriculture which carries the principal statistics on crop and livestock production, movements, prices, stocks, and foreign trade on all products covered by the department's work. It carries information as to the acres of crops planted and harvested, the condition of these crops during the year, estimates of the number of livestock on farms, the amounts of different products marketed and on hand, and other related information on crop and livestock production and prices. Copies of Crops and Markets may be seen in the office of the county agent. The subscription price is 60 cents a year.[3]

SPECIAL COMMODITY-PRICE STUDIES

In recent years the United States Department of Agriculture and some of the State colleges of agriculture have undertaken careful studies of the factors affecting the prices of specific farm commodities and thorough-going analyses of conditions confronting producers of certain commodities. Among the available bulletins that discuss factors affecting prices of specific commodities are the following: Department Bulletin 1440, Factors Affecting the Price of Hogs; Department Bulletin 1351, What Makes the Price of Oats?; Department Circular 416, Demand, Marketing, and Production of Oregon and Washington Prunes.[4] A letter to the State college or extension service may bring you State bulletins relating to local studies.

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[3] Payable in cash or money order to the Superintendent of Documents, Government Printing Office, Washington, D. C.

THE AGRICULTURAL SITUATION

The Agricultural Situation is a summary of national farm conditions issued monthly by the United States Department of Agriculture. It carries a general summary of conditions throughout the country, and from time to time it prints special reports for particular sections or commodities. It also carries data showing price trends during the past few years. This publication may be obtained from the United States Department of Agriculture; the present subscription price is 25 cents per year. It is sent to all county agricultural agents. Many of the State colleges of agriculture issue similar reports, which may be obtained from the county agent or by writing to the State college of agriculture.

YEARBOOKS

Each year the United States Department of Agriculture publishes the Yearbook which carries, among other things, a large amount of statistical information on prices. Each Congressman and Senator send out a number of these Yearbooks free. Other copies may be obtained from the Superintendent of Documents, Washington, D. C., at $1.50 per copy.

Most of the State departments of agriculture issue yearbooks which carry much of the information for the particular State carried in the Yearbooks of the United States Department of Agriculture and usually some additional information.

ANNUAL AGRICULTURAL OUTLOOK REPORTS

In January of each year the Bureau of Agricultural Economics of the United States Department of Agriculture and many of the State colleges of agriculture issue agricultural-outlook reports which discuss the probable trends in prices during the coming year for each of the principal farm commodities. When the intentions-to-plant reports, which carry information as to planting intentions of farmers regarding the principal crops are issued in the spring, additional statements as to the outlook may accompany them. Outlook reports for crops planted other than in the spring are issued at other times during the year. Reports that show farmers' hog-breeding intentions are issued in June and December. Similar reports are issued from time to time for other classes of livestock. These reports may be seen in the office of the county agent or may be obtained by writing to State colleges of agriculture or to the United States Department of Agriculture.

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[4] CRITCHFIELD, B. H. DEMAND, MARKETING, AND PRODUCTION OF OREGON AND WASHINGTON PRUNES. U. S. Dept. Agr. Circ. 416, 48 pp., illus. 1927.

HAAS, G. C., and EZEKIEL, M. FACTORS AFFECTING THE PRICE OF HOGS. U. S. Dept. Agr. Bul. 1440, 68 pp., illus. 1926.

KILLOUGH, H. B. WHAT MAKES THE PRICE OF OATS? U. S. Dept. Agr. Bul. 1351, 40 pp., illus. 1925.

STATISTICAL BULLETINS

The United States Department of Agriculture is issuing a series of statistical bulletins which give all pertinent statistics for the chief agricultural commodities. The series includes a group of four price bulletins, which tabulate the prices paid to producers for the chief farm products over a series of years.

Of the sources of price information mentioned, the outlook reports and the Agricultural Situation carry conclusions as to probable price trends during the months just ahead. Crops and Markets and intentions-to-plant reports carry information such as is considered in arriving at the conclusions indicated in these reports. Bulletins based upon special price studies usually carry conclusions for a somewhat longer period. The other sources mentioned carry data that are useful in making an analysis of the price situation of the principal farm commodities.

In reaching conclusions as to prices care should be exercised lest too much weight be given to those of the present or of the immediate past. It should be remembered that the prices of farm products fluctuate widely from year to year and that the changes are seldom uniform. Research studies made by the United States Department of Agriculture and the State colleges of agriculture show price cycles or fairly definite price trends or both for many farm products. For these reasons, as much time as possible should be given to the study of average prices, price trends, and market-outlook information and to the consideration of studies made by others before the prices to be used in making the budget are decided upon.

PRODUCTION INFORMATION TO BE USED

Generally normal or average crop and livestock requirements, yields, and production should be used in making a budget. The yields for crops and the production for livestock vary from year to year, but the variations depend largely upon such factors as temperature, rainfall, insect pests, and livestock diseases, which can not be anticipated with any degree of accuracy. The best the farmer can do is to review his own experience and such records as are available for his farm, study records and accounts showing the results on other farms, and data showing the results of experiments in growing crops and feeding livestock; then consider all of these facts in the light of conditions on his own farm, and make the best approximations possible.

In the case of crops, an effort should be made to find out the yields that may reasonably be expected from different quantities of seed and fertilizer and the quantities of these and other materials that will probably result in the largest returns, in the light of conditions on the farm and of prices that may reasonably be expected. In the case of livestock, an effort should be made to determine the production that may reasonably be expected to result from different rations and the particular ration that will result in the largest returns, considering the home-grown feeds and pasturage available and the prices expected for feeds, livestock, and livestock products.

SOURCES OF PRODUCTION INFORMATION

Among the important sources of information on production are the following:

Records for the farm and similar records in the community.

Records showing county and State crop yields.

Books, bulletins, and reports showing the results of livestock feeding and crop experiments of the United States Department of Agriculture and State colleges of agriculture.

Demonstrations showing the results of practices in the community.

RECORDS FOR FARM AND COMMUNITY

Records showing the results that have been obtained on one's own farm from different fertilizer and cultivation practices for crops and feeding practices for livestock are extremely useful in forming judgments as to crop and livestock production that may reasonably be expected in the future. Similar records for other farms in the community or with similar conditions are also useful.

During the past few years thousands of farmers in different parts of the United States have kept records of farming operations in cooperation with the State colleges of agriculture and the United States Department of Agriculture. These records are usually summarized and analyzed by State and Federal agencies and the results are made available in bulletins and reports. Such reports may be obtained from the county agent or by writing to the State college of agriculture or the United States Department of Agriculture.

COUNTY AND STATE YIELDS

The Yearbooks of the United States Department of Agriculture carry data that show State crop yields for the principal crops for several years. The yearbooks of the State departments of agriculture carry data that show county crop yields for a period of years. Such data indicate in a general way trends in yields and the variations that are probable for a particular year.

EXPERIMENTAL RESULTS

Ever since its establishment in 1862, the United States Department of Agriculture has been conducting experiments in growing crops and in feeding livestock. Since the passage of the Hatch Act in 1887, and in some cases before, experimental work of a similar kind has been done by the State agricultural experiment stations. More recently, branch experiment stations and experiment fields have been established by most of the States, and now experimental results are available on crop and livestock production which are applicable to most sections of the country. These experiments show the results of feeding different rations to livestock and of different practices in growing crops. These results are published from time to time in bulletins and special reports, which may be obtained from the county agent or by writing to the State colleges of agriculture or to the United States Department of Agriculture. Books are also published from time to time discussing the results of experimental work.

DEMONSTRATIONS IN COMMUNITY

In most parts of the country, in cooperation with the county agents, farmers conduct demonstrations to show the possibilities of practices or lines of production other than those commonly followed in the community. Such demonstrations are very valuable if new practices or new lines of production are contemplated. The careful consideration of practices and systems worked out by successful farmers is also helpful.

Of the sources mentioned, the publications which carry results of experiments are likely to be most useful in determining the yields that will probably result from the use of different fertilizers or other practices, and the livestock production that will probably result from different rations. One's own experience and records showing the results on other farms will be useful in localizing and interpreting the experimental data in terms of conditions on the farm and in determining the crop and livestock production that will probably result from the practices commonly followed in the community.

A careful study of production information, such as that described above, will provide a basis for conclusions as to the crop yields that are most likely to be obtained, the quantities of the different kinds of feeds normally required to produce 100 pounds of pork or to put 100 pounds of gain on steers, or to keep a cow or a horse a year. A similar study of the information mentioned and such other information as may be available on prices will provide a basis for conclusions as to the prices that are most likely to prevail during the coming year and during a longer period. A method of recording conclusions of this kind is shown in Tables 3, 4, and 5, pages 17 and 18.

The analysis of these data and the formulation of judgments as to production and price relations that appear probable at a particular time constitute one of the preliminary yet essential steps in the budget-making process. Such an analysis provides a basis for adjusting the practices and enterprises to the economic conditions of the time.

FORMS FOR FARM-BUDGET MAKING

In the following pages a set of sample forms is shown. These forms illustrate a method of organizing facts that should be considered and the kinds of forms needed to work out a farm budget. The facts may be organized and a farm budget made by observing the following procedure:

First, list the products that appear to have possibilities as sources of income, as indicated by the marketable-products column, Table 3. Next list the different kinds of feed, seed, fertilizer, and other items that are to be used in getting these products, as indicated by the expense-items column below. Next, an examination should be made of the data as to average prices, price trends, and the market outlook for each of these marketable products, and expense items should be examined. When as much time as practicable has been given to the study of the price situation, enter the prices that appear probable for the items that will need to be bought and for the products to be sold. Entries should be made showing the prices expected during the coming year and the average prices expected for a period of years.

Table 3.—*Prices for products to be sold and expense items*

Products to be sold			Expense items		
Item	Expected average prices, next 5 years	Expected prices coming year [1]	Item	Expected average prices, next 5 years	Expected prices coming year [1]
Cash crops:	*Dollars*	*Dollars*	Feeds:	*Dollars*	*Dollars*
Wheat........per bushel..	1.25	1.35	Bran per hundred weight..	1.75	1.75
Tobacco........per pound..	.11	.09	Cottonseed meal....do....	2.10	1.90
Soy beans.....per bushel..	2.00	2.00	Tankage..............do....	3.50	3.50
Corn...................do....	.70	.70	Meat scraps..........do....	4.00	4.00
Mixed hay.........per ton..	16.00	16.00	Oyster shells.........do....	1.25	1.25
Livestock:			Fertilizer:		
Whole milk			Acid phosphate..per ton..	22.00	22.00
---per hundred weight..	2.10	2.10	Seeds:		
Veal.............per pound..	.08	.08	Red clover.....per pound..	.27	.27
Hogs per hundred weight..	8.50	8.50	Orchard grass........do....	.14	.14
Old hens........per pound..	.18	.18	Alsike clover.........do....	.22	.22
Young poultry.....do....	.22	.22	Redtop................do....	.25	.25
Eggs.............per dozen..	.22	.20	Miscellaneous:		
			Canvas..........per yard..	.05	.05
			Arsenate of lead		
			..............per pound..	.25	.25
			Twine...................do....	.12	.12
			Threshing wheat		
			..............per bushel..	.12	.12

[1] The prices in the "coming year" columns were used in making out the budget shown on pp. 2 and 3.

Table 4.—*Normal yields and production requirements for crops—per acre basis*[1]

Crops	Seed	Fertilizer and other materials		Yield
		Kind	Quantity	
Tobacco..................	....	Superphosphate (acid phosphate). Arsenate of lead.... Canvas..............	300 pounds.... 5 pounds...... 10 yards......	1,000 pounds.
Corn......................	1/10 bushel..................	....	....	28 bushels.
Wheat.....................	1¼ bushels.................	Superphosphate.... Twine............... Threshing...........	200 pounds.... 2 pounds...... 12 cents per bushel.	14 bushels.
Soy-bean hay..............	¾ bushel....................	....	....	1¼ tons.
Soy-bean seed.............	.....do.....................	....	....	15 bushels.
Mixed hay.................	Red clover, 5 pounds; orchard grass, 5 pounds; alsike clover, 3 pounds; redtop, 2 pounds.	....	....	1 ton.

[1] The yields and production requirements shown here were used in working out the budget shown on pp. 2 and 3.

List the crops that are being considered for the farm as indicated by Table 4. Next enter the yields and the seed, fertilizer, and other material requirements necessary to get these yields. The yields should represent one's best judgment as to normal expectations from the requirements shown and practices contemplated. Often it will be advisable to record 2 or more yields for a particular crop, each representing the production expected from a particular quantity of fertilizer, seed, or practice.

TABLE 5.—*Normal feeding requirements and production for livestock*[1]

Livestock	Home-grown feeds		Purchased feeds		Production	
	Kind	Quantity	Kind	Quantity	Kind	Quantity
Dairy cows, per head.	Corn	14 bushels	Bran	250 pounds	Whole milk	5,000 pounds.
	Soy-bean hay.	1 ton	Cottonseed meal.	do	Veal [2]	80 pounds.
	Mixed hay	do				
Heifers, per head	do	½ ton				
Veal calves	Whole milk	500 pounds				
Hogs, 1 sow, 8 pigs.[3]	Corn	128 bushels	Tankage	500 pounds	Live weight	1,600 pounds.
Poultry (per 100 hens).	do	100 bushels	Oyster shells	do	Old hens	200 pounds.
	Skim milk	1,032 pounds	Meat scraps	do	Young poultry.	150 pounds.
					Eggs	900 dozens.
Work horses, per head.	Corn	45 bushels				
	Mixed hay	2 tons				

[1] The feed and other requirements and production shown here were used in working out the budget shown on pp. 2 and 3.

[2] The veal production shown is based upon the assumption that 1 veal calf weighing 160 pounds would be sold for each cow every other year.

[3] The requirements shown are based upon 8 bushels of corn and 31 pounds tankage per 100 pounds of gain.

List the different classes of livestock being considered as shown in Table 5. Next enter the normal yearly feed and other requirements and production for each class of livestock. Often it may be advisable to record varying amounts of feed for a particular class of livestock and the production that will normally result from such feed, the feed requirements being based upon different rations.

Tables 3, 4, and 5, when carefully filled out, provide basic data to be used in working out budgets for the different systems considered.

FORMS FOR THE FARM BUDGET

Section A: Acreage and cash expenses for crops

Crops	Acreage	Seeds and plants		Other expenses		
		Quantity	Cost	Kind	Quantity	Cost
Total						

When a cropping program has been tentatively decided upon, list the kinds of crops and acreage of each as indicated by Section A. Data for the remainder of the form may be obtained by multiplying the figures in the acre column by the production-requirement data recorded in Table 4, and the amounts obtained in this way by the prices shown in Table 3.

In deciding upon a cropping program, the number of acres of each crop that a given crew can handle and the extent to which different crops compete with and supplement and complement each other should be taken into account. (See budget, pp. 2 and 3.)

Section B: Production and disposal of crops

Crops	Production (quantity)	Disposal			
		For feed (quantity)	For seed (quantity)	For sale	
				Quantity	Value
Total					

List the crops again in the same order as on the preceding form, and enter the expected production as indicated in Section B. The production data may be obtained by multiplying the figures in the acre column of Section A by the crop yields listed in Table 4. The quantity of each crop that would be fed to livestock, used in the home and sold, should be indicated. The value of the quantities to be sold may be obtained by multiplying the quantities shown on this form by the prices shown in Table 3. If systems are to be compared that make available different quantities of products for home use, a value column headed "Used in the home" may be added. (See budget, pp. 2 and 3.)

Section C: Feeds and other expenses for livestock

Livestock	Number	Home-grown feeds		Purchased feeds			Other expenses	
		Kind	Quantity	Kind	Quantity	Cost	Kind	Cost
Total								

When a livestock program has been tentatively decided upon, list the different classes of livestock and enter the number of each opposite the class, as in Section C. Next calculate the amounts of home-grown and purchased feeds and other expenses. This may be done by taking the data in Table 5 and multiplying them by the numbers of livestock recorded on this form. The quantities of home-grown feed to be used should be compared with the quantities expected to be available for feed, shown on the preceding form. The value of the purchased feeds will be obtained by multiplying the quantities shown on this form by the prices recorded in Table 3. (See budget, pp. 2 and 3.)

It will often be advisable to work out two tables similar to this form, one showing how the feeds on hand at the beginning of the year are to be used and the other showing the feeds to be consumed by the livestock from the harvest season to the end of the year.

Section D: Production and disposal of livestock and livestock products

Livestock and products	Production (quantity)	Disposal			
		Fed to livestock (quantity)	Used in home (quantity)	Sales	
				Quantity	Value
Total					

List the livestock and livestock products in the same order that they are entered on the preceding form, as indicated by Section D. Data for the production column may be obtained by multiplying the figures in the "number" column, Section C, by the production data recorded in the last column of Table 5. The quantity to be fed, used in the home, and sold should be entered. The quantities to be sold, multiplied by the prices shown in Table 3, will give the data for the "value" column. (See budget, pp. 2 and 3.)

Section E: Summary of receipts and expenses

Receipts	Total value	Expenses	Total value
Total		Total	
Net returns			

Bring forward the "value" and "cost" totals on the four preceding forms and enter "value totals" under receipts, and the "cost totals" under expenses. In addition to the direct costs for crops and livestock brought forward, include on the expense side the estimates for labor to be hired, new machinery and repair, new fences and fence repair, building repair, taxes, farm insurance, and other overhead items. In some cases it may be advisable to include an estimate of sales from miscellaneous sources on the receipts side. The total expenses subtracted from the total receipts give the net returns. (See budget, pp. 2 and 3.)

Acres of crops, numbers of livestock provided in the plan for the coming year and in the long-time plan, expected receipts and expenses, and those actually obtained on your farm

Item	Last year	Long-time plan	Plan for coming year	Actual results, end of year
Crop:	*Acres*	*Acres*	*Acres*	*Acres*
Livestock:	*Numbers*	*Numbers*	*Numbers*	*Numbers*
Results:	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Farm receipts				
Farm expenses				
Net returns				

At the beginning of the year, enter the acres of the different crops grown, the numbers of livestock kept, and the cash receipts and expenses for your farm for last year in one column as indicated above. Record the acres of crops and the numbers of livestock provided in the long-time plan for your farm, and enter the average receipts and expenses expected in the next column. In the third column, enter the acres of crops, the proposed numbers of livestock, and the receipts and expenses expected for the coming year. At the end of the year, enter in the last column the acres of crops actually grown, the numbers of livestock kept, and the receipts and expenses that actually resulted.

Forms to be used in making a farm budget as described in this bulletin may be obtained by writing the United States Department of Agriculture.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1565

SHALL I BUY A COMBINE ?

SMALL GRAINS, soy beans, clovers, grain sorghums, and other crops have been harvested and threshed successfully with combines. Combines can also be used for stationary threshing.

The advantages of the combine in comparison with other methods of harvesting and threshing are the saving of labor, the eliminating of transient labor, the early clearing of fields for tillage operations, the distributing of the straw on the land, and the getting of the grain to market earlier.

The disadvantages are the large investment required, the large amount of power consumed, the greater risk from damp grain, the greater risk to crops from storms, and the difficulty of saving the straw for feed and bedding.

Combines range in size from machines which cut an 8-foot swath to those which cut a 24-foot swath. Ten-foot combines will cut 20 to 25 acres a day and 15-foot combines 30 to 35 acres or more. Combines cost from $1,000 to $3,000 and require 6 to 12 horses, or tractors of from 9 to 20 drawbar horsepower.

A combine should not be purchased for harvesting less than 100 to 150 acres annually. For smaller acreages other methods will usually be more economical.

Harvesting and threshing losses need be no greater with combines than with other methods of harvesting and usually are less.

This bulletin is based on information obtained cooperatively by the Division of Farm Management and Costs of the Bureau of Agricultural Economics, the Office of Cereal Crops and Diseases of the Bureau of Plant Industry, the Division of Agricultural Engineering of the Bureau of Public Roads, and the agricultural experiment stations of Kansas, Montana, Nebraska, Oklahoma, and Texas, in 1926; and of Illinois, Indiana, Pennsylvania, South Dakota, and Virginia, in 1927. A complete discussion of the 1926 study is given in Technical Bulletin No. 70, The Combined Harvester-Thresher in the Great Plains.

Washington, D. C. Issued April, 1928

SHALL I BUY A COMBINE?

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THE PROBLEM of deciding whether to purchase a combine or to continue harvesting by the older methods is one that many farmers are trying to solve. This bulletin discusses the most important points to be considered by those who are endeavoring to decide whether to purchase one of these machines. It is based on information obtained from owners of combines and embodies the results of studies conducted in different sections in the Great Plains, in the Corn Belt, and in Eastern States.

The ability of the combine to harvest and thresh grain successfully has been demonstrated from the time the early machines were perfected. The first combine was built over 50 years ago. The early models were soon improved to the extent that the machines showed their value for harvesting wheat in the large wheat-growing districts of the Pacific coast. The small, prairie-type combine equipped with an auxiliary engine, such as is now used in the Great Plains, the Corn Belt, and Eastern States, was introduced and its adaptability demonstrated in the wheat fields of Oklahoma and Kansas in 1918.

The advantages of the combine, in comparison with other methods of harvesting and threshing as reported by farmers are the saving in harvesting and threshing costs, the decreased labor, the elimination of hired help, the earlier clearing of the field for tillage operations, the distribution of the straw on the land, and the earlier marketing of the crop.

The chief disadvantages of the combine are the large investment necessary, the large amount of power required, the fact that the grain is more likely to be damp, the greater risk to crops from storms, and the loss of straw for feed and bedding unless additional labor is expended in picking up the straw after the combine.

CROPS THAT CAN BE HARVESTED WITH COMBINES

Wheat, barley, oats, rye, emmer flax, grain sorghums, buckwheat, rice, soy beans, cowpeas, sweet clover, red clover, alsike clover, timothy, and alfalfa have been harvested and threshed with combines with varying degrees of success.

In the Pacific Coast States wheat and barley are practically the only crops harvested with a combine because the machine is used in districts where these are the principal small-grain crops. As the method used in threshing, separating, and cleaning the grain in a combine is identical with that used in most stationary threshing machines, the combine was tried for harvesting other crops soon after it was introduced into the Great Plains and the regions further east. In the Corn Belt and the Eastern States wheat, oats, barley, buckwheat, soy beans, sweet clover and other clovers, and a few miscellaneous crops have been harvested successfully. Farmers in the Great Plains, have also used combines successfully when harvesting oat, rye, emmer, flax, and grain sorghum.

WHEAT

Ordinarily no difficulty is experienced by operators in harvesting wheat, as it usually stands well after ripening. In lodged grain some difficulty may be encountered, as it is necessary to cut the straw lower down the stalk. Under humid conditions wheat tends to bend down after maturity and may be completely lodged if allowed to stand too long, or it may lodge before it is ripe. The added bulk caused by the longer straw may clog the machine before the grain reaches the cylinder or may so overload the sieves and chaffer that it may be necessary to cut a narrower swath. If the crop is harvested at the proper stage of maturity and dryness the grain will be equal in quality and condition to that harvested and threshed by other methods. Shattering of the grain seldom occurs in most varieties of wheat grown east of the Rocky Mountains even when it is left three or four weeks after maturing.

OATS

Oats that are erect can be harvested with a combine as easily as can wheat. The oat plants frequently fall over shortly after maturity, especially during wet weather, and this greatly increases the difficulty of combine harvesting. Under dry conditions oats shatter rather easily after they are fully mature. If green weeds extend up through the lodged oats the threshing of the grain is interfered with. Owing to the danger of a lodged crop, the combine should not be depended upon to harvest more oats than can be cut within four or five days after the crop reaches maturity. The adjustments of the combine necessary for threshing oats consist of cutting down the wind, opening up the chaffer sieves, and removing the small wheat screen.

BARLEY

Barley can be harvested with a combine almost as easily as can wheat. The varieties of barley grown in the Great Plains and in the Eastern States are more susceptible to lodging and shattering than are the barleys of the Pacific Coast States, or most varieties of wheat. The threshing of barley with the combine is only slightly different from the threshing of oats. The concaves should be raised slightly, and the wind should be increased.

RYE

Rye usually is taller than other small grains and the straw is tougher, but it is not too tall for combine harvesting. Rye shatters more easily than does wheat and is more easily threshed from the heads. Rye heads sometimes nod so much that the curved heads are thrown out by the combine reel. This loss can be reduced by placing wide slats on the reel.

EMMER

Emmer (speltz) can be harvested with the combine successfully. The crop stands well but is rather susceptible to shattering. Emmer is threshed with about the same adjustments that are used in threshing oats, except that the concaves are lowered more or more concaves are removed.

FLAX

Farmers who use their combines for harvesting flax state that it does excellent work after frost, when the plants are dry and brittle. Before frost a combine will do good work in clean fields, but in weedy fields considerable flax is lost because it is carried over with green weeds and straw.

GRAIN SORGHUMS

The combines now available are not fully adapted to harvesting grain sorghums because of the heavy stalks and the irregular height and irregular ripening of this crop. Many heads are lost in harvesting uneven sorghum crops. When grain sorghums are harvested with a combine it is necessary to cut off 12 to 20 inches of the stalk along with the head. When these stalks are green much of the juice is crushed out as they pass through the machine, with the result that the moisture content of the threshed grain is increased. When the plants are ripe or killed by frost before harvest the threshed grain is dry. But if the crop is allowed to stand until after a frost a high wind or storm may cause it to lodge. If it does, it will be impossible to use a combine, and the crop will have to be harvested by hand. Grain sorghums which are mature, erect, and of even height can be harvested with the combine with very little loss if the machine is properly adjusted. The adjustments consist of the use of wider reel slats, and screens at the back and end of cutting platform; reduced cylinder speed; and the lowering or removing of concaves.

SOY BEANS

Nearly every farmer who owns a combine and who raises soy beans uses the machine to harvest his crop. (Fig. 1.) Harvesting with a binder, a bean harvester, or a mower is often unsatisfactory because of the heavy bean losses. Many owners in the Corn Belt purchased their combines especially for harvesting soy beans.

Owing to the lateness of the harvest season and the habit of growth of soy beans, the harvesting of this crop is accompanied with more hazard and difficulty than is the harvesting of small grains. Harvesting is aided by early sowing of early-maturing varieties which shatter little. If the soy beans are cut sufficiently early the disk and wheat drill may be pulled directly behind the combine, and the strip of land seeded to wheat will be covered with a thin layer of straw on the next round of the combine.

The loss of beans harvested by the combine is greater than for small grains, but there is a decided saving in combining beans over other methods of harvesting. The greatest losses in harvesting are due to low pods which are missed by the cutter bar, the lowest adjustment of which cuts about 4 inches or more above the ground. Thicker planting tends to produce taller plants with fewer low pods.

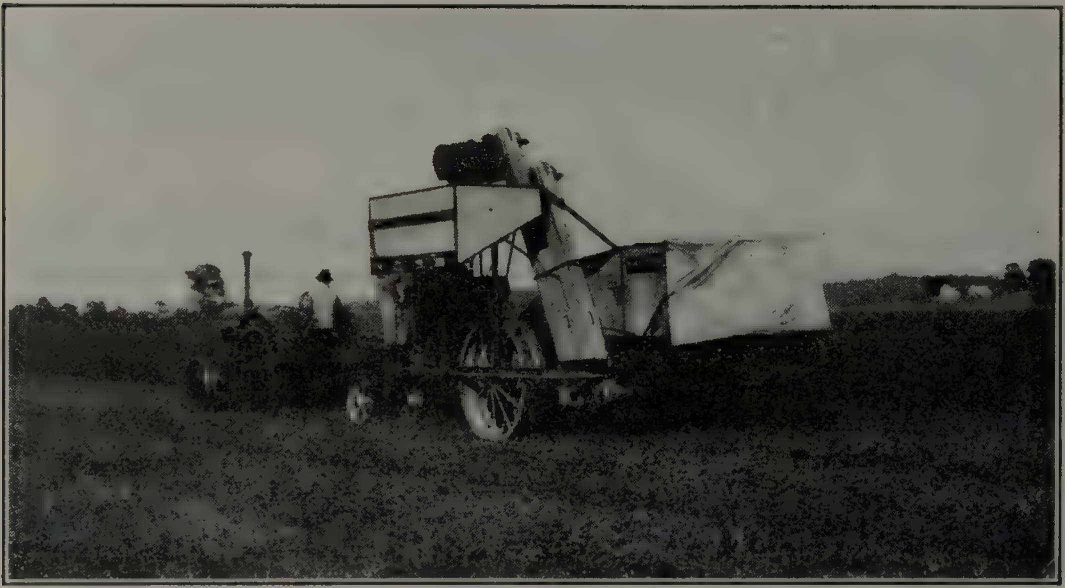

Fig. 1.—In Illinois and Indiana, on farms where combines are owned, the machine has superseded the binder and mower for harvesting soy beans, as it saves a larger percentage of the crop

In harvesting soy beans the speed of the cylinder should be reduced approximately 50 per cent below that required for wheat, to prevent cracking the beans, the separating unit of the machine being kept at the same speed to insure proper cleaning and quick disposal of the green material. If the crop is uniformly mature no concave teeth are needed, but concaves must be used if beans are not thoroughly ripe, in order to insure clean separation. The cylinder can be slowed down when soy beans are being threshed either by placing a smaller pulley on the motor shaft or a larger pulley on the cylinder shaft, and the usual speed of the remainder of the threshing unit can be maintained by putting a larger sprocket on the driving end of the cylinder shaft. These are necessary items of equipment for the proper operation of the machine in both bean and pea harvest.

BUCKWHEAT

A few farmers have harvested buckwheat with combines. Difficulty has been encountered because of the irregular ripening of the crop and the presence of green stalks at harvest time.

RICE

Some rice has been harvested with the combine in recent years, but the use of the combine was successful only when accompanied by the artificial drying of the threshed grain.

CLOVER, ALFALFA, AND TIMOTHY SEED

The common methods of harvesting sweet clover have always been more or less unsatisfactory because of the large quantity of seed lost by shattering. In the last two or three years some growers have tried the combine and found that by using it they were able to save considerably more seed than by other methods. Because of its uneven ripening and rank, spreading growth sweet clover is rather difficult for the combine to handle. Threshed seed frequently has to be dried because of the immature seeds and green material which it contains. The results obtained, however, may offset the difficulties encountered. Other clover, as red, alsike, and mammoth red, have also been successfully harvested by combines. Some combine owners have used their machines for harvesting timothy and alfalfa for seed.

THE COMBINE AS A STATIONARY THRESHER

The use of a combine need not be confined entirely to harvesting standing crops. Many farmers thresh small acreages of bound grain, such as oats, with a combine if the straw is desired for feed or bedding. Many grain-sorghum growers who harvest their crop with headers or with corn binders, or by hand, thresh the heads later with the combine.

If the combine is to be used extensively as a stationary thresher, a feeder and straw carrier will add to its efficiency. The feeder is attached in place of the cutting and elevating platform and serves to carry the bundles into the cylinder of the combine. When combines are used without a feeder for stationary threshing, the reel and sickle are removed, and the bundles are pitched on to the platform canvas. The bundles are then carried into the cylinder after the bands are cut.

When a straw carrier is attached the straw can be stacked better and more easily. If the straw is not to be saved stacking is unnecessary as the combine can be moved at intervals rather easily.

The threshing portion of the combine is nearly identical with the ordinary threshing separator and is adjusted in a similar manner.

TYPES OF COMBINES AND EQUIPMENT

In purchasing a combine there are several types from which to choose. The type first developed for use in the Great Plains is equipped with an auxiliary engine and is pulled by horses or tractor. (Fig. 2.) This type is made in several sizes, the size being governed by the length of the cutter bar which ordinarily is 9, 10, 12, 15, or 16 feet long. Of these sizes only the first three are common in the Corn Belt and in the Eastern States, whereas in the Great Plains the majority are of the larger sizes. A few machines with 20 and 24 foot cutter bars are used in the Great Plains, but these are too large except for use on big wheat ranches.

Combines with a 9-foot or 10-foot cut drawn by a tractor with a direct power drive from the tractor were introduced in 1926. (Fig. 3.) Such a machine has advantages in that it can be operated by one man and in that it requires a smaller investment than do the large machines which have auxiliary motors. It is not satisfactory when a large quantity of straw is to be cut or in loose soils because there is insufficient power for threshing unless the tractor is run in low gear.

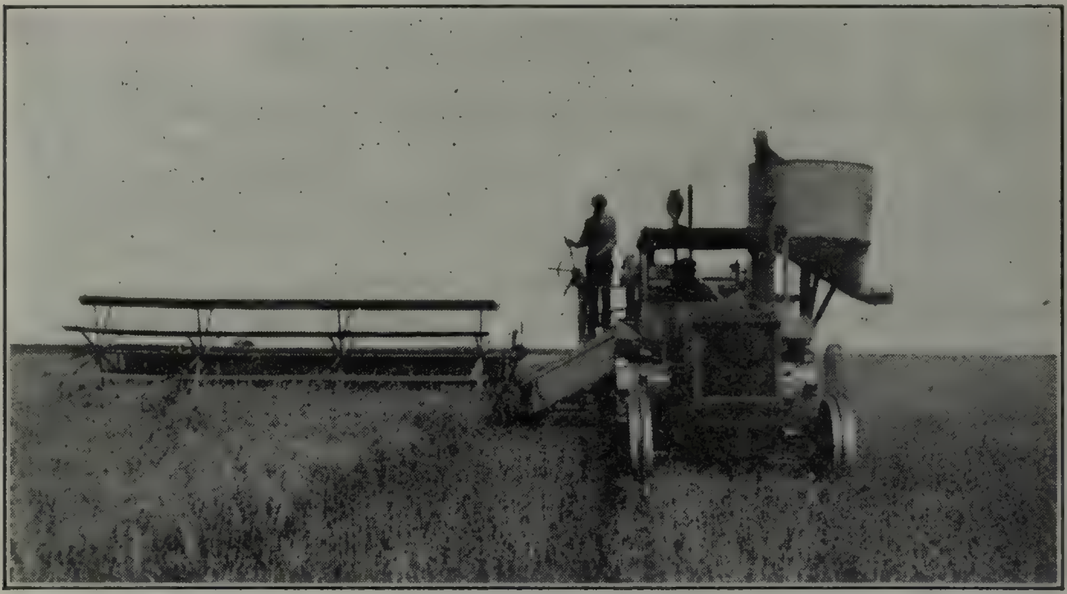

FIG. 2.—A large type of combine used in the Great Plains and used to a limited extent in the Corn Belt. A crew of two men with this machine can harvest and thresh 30 to 50 acres of grain per day

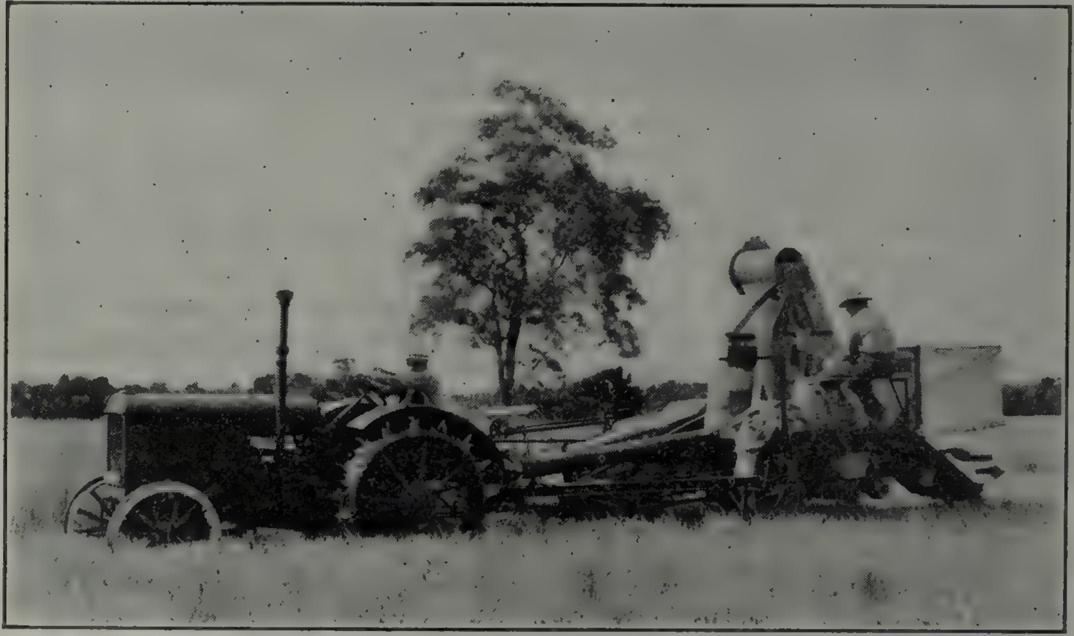

FIG. 3.—This type of power drive combine is built in two sizes. It requires a smaller investment than does a machine of the same size that is equipped with an auxiliary motor. It has a further advantage in that it can be operated by one man if the grain is handled in bulk. Two men are required on the outfit shown here because the grain is being threshed into sacks

A third type of combine, also introduced in 1926, is mounted on the tractor from which it obtains its power. (Fig. 4.) This machine has an 8-foot cutter bar located directly in front of the tractor and differs radically from all others in that an auger is used instead of canvases on the cutting platform. These small power-driven machines are used mostly on farms which have small acreages of grain.

Special hillside combines with leveling devices are built by most manufacturers for use in the Pacific Northwest. These combines can be used on slopes as steep as can be harvested with any harvesting machinery. Hillside combines of the smallest size may find a place in some portions of the East.

The 8-foot combines require a certain make of tractor for operation, with about 9 drawbar horsepower; the 9 and 10 foot power take-off combines require tractors with about 15 drawbar horsepower. The 9 and 10 foot combines with an auxiliary motor require about 6 horses, or tractors with 9 to 12 drawbar horsepower. The 12-foot machines require 6 to 8 horses, or tractors of 12 to 15 drawbar horsepower; the 15-foot and 16-foot machines about 8 to 10 horses, or tractors of 15 drawbar horsepower; the 20-foot machines usually require about 12 horses, or tractors with 20 or more drawbar horsepower. (Fig. 5.) On the hilly farms in the Pacific Northwest, which have loose ashy soil, combines with auxiliary engines usually are drawn by 12 to 30 horses.

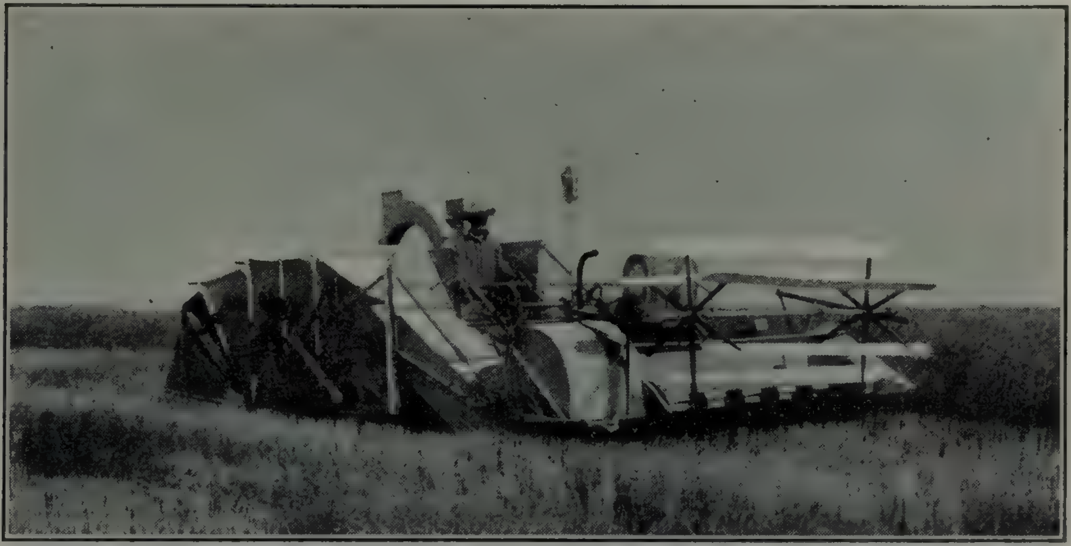

FIG. 4.—The smallest type of combine now on the market. On this machine the cutter bar is directly in front of the tractor, and the machine is operated by one man

EXTRA EQUIPMENT

Many combine operators may want some extra equipment which is not included in the purchase price of their machines. The chief items of equipment which may be added to the machine are the grain tank, the grain-wagon hitch, the brakes, the transport wheel or truck, the extension to the cutter bar and platform, the straw spreader, and the straw buncher. Other items of less importance are the sacking attachment, the self-feeder, and the straw carrier. The latter two are used only for stationary threshing. Sprockets and pulleys for changing the speed of the reel and cylinder when threshing peas, beans, and grain sorghums are also available, as are clover and alfalfa seed attachments, special sieves, and windrow and shock pick-up attachments.

GRAIN TANK

If the grain is hauled by motor truck there is a distinct advantage in using the grain tank on the combine, as the grain can be run directly from this tank to the truck, thus eliminating the labor of scooping. If grain is stored on the farm or hauled to market in wagons the use of a grain tank on the combine may not save any appreciable amount of labor. Many combines now come equipped with grain tanks. (See figs. 1, 2, and 4.)

GRAIN-WAGON HITCH

A combine which is not equipped with a grain tank or sacking attachment usually requires a grain-wagon hitch so that the grain wagon can be trailed along by the combine, thus saving the time of a man and team. When one wagon is full, another can be substituted with little lost time.

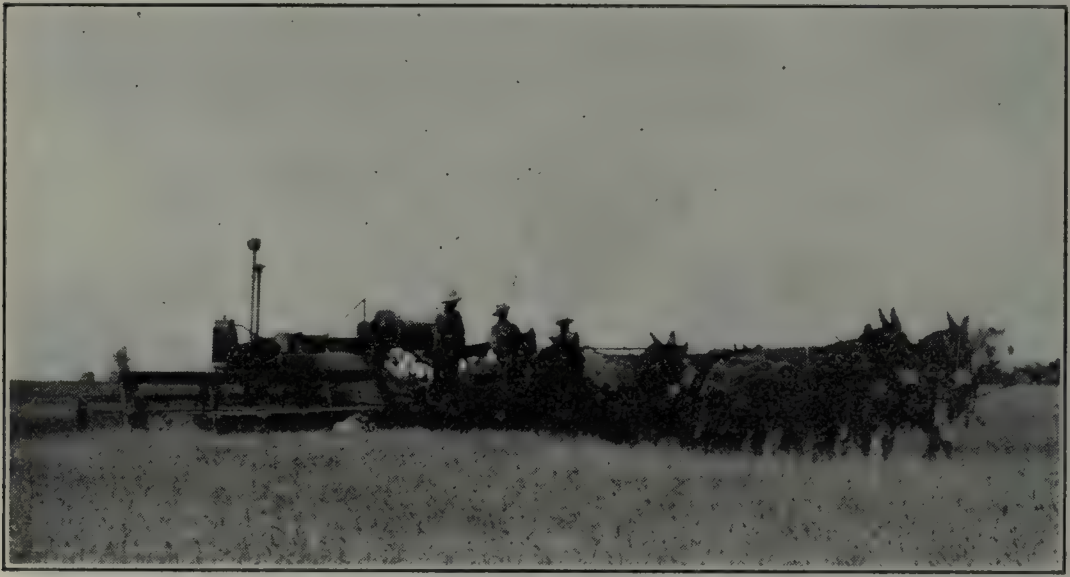

FIG. 5.—Horses or mules are sometimes used to pull the combine, but the tractor is generally considered to be more steady and reliable power

BRAKES

All sidehill and some prairie-type combines are equipped with brakes. Brakes are necessary in hilly fields and when the combine must be pulled over roads which have steep grades.

TRANSPORT WHEEL OR TRUCK

A transport wheel or truck often is needed to carry the cutter platform when a combine is being moved along roads or lanes which are too narrow to permit the machine to pass with the cutter platform attached. The platform folds back or up on most machines, but on others it must be removed and carried on a truck. Some of the folding platforms require transport wheels.

EXTENSION CUTTER BAR AND PLATFORM

Most combines are equipped with cutting platforms which are long enough for ordinary conditions. If yields are low the threshing unit can handle more grain than the regular platform will cut, and extensions of 2 to 4 feet in length can be attached to the platform and reel, and a new sickle of the right length can be provided. These extensions are desirable in regions which are subject to drought and consequent light crops.

STRAW SPREADER

On most machines straw spreaders are optional equipment. The spreader distributes the straw behind the machine uniformly and not in a narrow windrow. When the straw is spread it can be plowed under without difficulty, but when left in a narrow strip it can be saved by the use of a hay loader and straw rack or raked in piles with a hayrake.

STRAW BUNCHER

Straw bunchers which hold the straw and drop it in piles can be attached to the rear of most makes of combines. The dumping is accomplished with a trip rope. Straw bunched in piles is convenient either for hauling, for field baling, or for burning.

OTHER ATTACHMENTS

If combined grain is to be handled in sacks instead of in bulk, a sacking platform and sacking spouts are necessary. (Fig. 3.) These attachments permit the sacks to be filled, tied or sewed, and dropped on the ground while the combine is operating.

A self-feeder and a straw carrier are necessary when the combine is used as a stationary thresher.

For auxiliary-motored combines a smaller pulley or sprocket should be used on the crank shaft of the motor for reducing the speed of the cylinder when beans, peas, and grain sorghums are being threshed; otherwise some grains may be cracked. A larger sprocket on the driving end of the cylinder shaft will then maintain the speed of the remainder of the threshing unit.

Recleaners, fine screens, and corrugated teeth are extra equipment needed for threshing clover and alfalfa.

Attachments are now available for some combines which will pick up the loose unthreshed crop from a windrow or the bound crop from a shock row and carry it into the combine for threshing. When this equipment is used the grain is first cut with a binder or header, or the cutting platform of the combine detached and used as a header, then left in shocks or windrows to ripen and dry. After it is dry it is picked up and threshed with the combine.

COST OF COMBINES

The small 8, 9, and 10 foot power-driven machines cost $1,000 to $1,200. The auxiliary-motored machines ranging in size from 9 to 16 feet cost from $1,500 to $3,000. Equipping the combine with some of the items of extra equipment may increase the first cost as much as 10 per cent.

On account of the large investment, farmers who have only small acreages of grain to harvest should consider carefully the first cost of different types of harvesting machinery before purchasing a combine. The possibility of doing custom work for neighbors should not be given much consideration in making a choice in favor of the combine, because as more machines are put into use returns from this source will become more limited each year. Farmers who have small acreages may sometimes find it advisable to buy a machine in cooperation with neighbors. If the harvesting equipment is nearly new it may be advisable to continue its use for several years longer before disposing of it and buying a combine.

Unless a tractor of sufficient horsepower to pull a combine with an auxiliary engine is already owned it will be necessary to buy one or to use horses to pull the combine. Many Corn Belt and many eastern farmers, however, do not have enough horses to pull a combine. Horses are considered satisfactory for use on these machines but only a few operators use them. If a power-driven combine is purchased it usually will be necessary to use a tractor of specific make and size having a power take-off attachment.

RATE OF HARVESTING

The rate of harvesting with a combine varies with the crop, the yield, the size of machine, the size of fields and crew, rate of travel, and length of day.

The 10-foot machines will cut an average of 20 to 25 acres of small grain in a 10-hour day and a 15-foot auxiliary-motored machine will cut about 35 acres per day. In 15 working days the 10-foot machine should be able to harvest 350 acres and the 15-foot machine 500 acres. In the East, where fields are rougher, smaller, and more irregular and the straw is heavier than in the Great Plains, smaller acreages would be cut. In harvesting soy beans in the Corn Belt the 10-foot combines averaged about 2 acres per hour for a six-hour day. A 15-foot combine will harvest about 24 acres of grain sorghum per day.

As many as 650 acres of wheat have been cut in a season with a 10-foot power-driven combine, and 1,100 acres have been cut with a 15-foot machine in the Great Plains. In the Corn Belt in 1927 the maximum acreage cut with a single 10-foot combine was 675 acres. This acreage included wheat, oats, buckwheat, and millet. A longer harvesting period is possible where several crops or varieties are grown which mature at different times.

In lodged or very weedy grain the acreage cut per day or per hour will be much lower than that in clean erect grain.

COST OF COMBINING

The chief items of operating expenses in combining include the use of a tractor or horses, fuel, lubricants, labor, and repairs on the combine.

Tractors which are pulling combines with auxiliary engines consume about three-fourths to 1 gallon of fuel per acre and 1 gallon of oil to 20 or 30 acres. Tractors with a power drive for the combine consume about 1¼ to 1½ gallons of fuel per acre. Auxiliary engines on the combines consume about one-half to three-fourths gallon of fuel per acre and about 1 gallon of oil for 40 to 60 acres. Eight-foot combines require only one man to operate them; 9 and 10 foot combines require one or two men, 12 to 16 foot combines two and sometimes three men; and the 20-foot combines three men for operation, all exclusive of grain hauling. The expense for repair parts averages about 10 cents per acre harvested. Repairs usually are furnished free during the first year of operation of the combine, providing the broken part shows defective material or workmanship. The longer a machine is used the greater the repair costs become.

Combines in the Great Plains, in the Corn Belt, and in the Eastern States, if operated and adjusted properly, may last about 10 years. The 10-foot combine with auxiliary motor, which is the size and type in most common use in these regions, costs about $1,500. On such a machine the yearly depreciation and interest charge would amount to $195. (See Table 1.)

TABLE 1.—*Depreciation and interest charges per acre for 10-foot and 16-foot combines harvesting various acreages, and total costs per acre for harvesting and threshing with 10-foot and 16-foot combines, 8-foot binders, and 12-foot headers*

Acres cut annually	Depreciation and interest charges		Total costs				
	10-foot combine	16-foot combine	10-foot combine in Corn Belt	16-foot combine in Great Plains	8-foot binder [1]		12-foot header [1]
					Corn Belt	Great Plains	
50	$3.90	----------	$5.13	----------	$4.04	$4.40	$3.46
100	1.95	$3.57	3.18	$4.65	3.72	4.08	3.27
150	----------	----------	2.53	3.43	3.62	3.97	3.21
200	.98	1.78	2.21	2.86	3.56	3.92	3.18
250	----------	----------	2.01	2.51	----------	----------	3.16
300	.65	1.19	1.88	2.27	----------	----------	3.14
400	.49	.89	1.72	1.97	----------	----------	----------
500	.39	.71	1.62	1.79	----------	----------	----------
600	.32	.60	1.55	1.68	----------	----------	----------
700	----------	.51	----------	1.59	----------	----------	----------
800	----------	.45	----------	----------	----------	----------	----------

[1] Including cost of hired separator for threshing.

In the Great Plains, where the annual acreage cut is larger, operators estimate a life of about eight years for their machines. A 16-foot combine in this region costs about $2,300. The depreciation and interest charge on this machine amounts to $357 annually.

The total costs of harvesting small grains with a 10-foot combine in the Corn Belt and with a 16-foot combine in the Great Plains in 1927 are shown in Table 1. These costs include depreciation, interest, repairs, fuel, and oil for both the combine and the tractor and a charge for all labor (exclusive of grain hauling) at going wages in 1927.

The table also shows the costs when an 8-foot binder and a hired stationary separator were used in the Corn Belt and in the Great Plains, and the costs when a 12-foot header and hired stationary thresher were used in the Great Plains. The slightly larger acre cost for the binder in the Great Plains is due to the higher wage rates paid in that region. With the exception of twine, the header costs include the same items as do the estimates for the binder. These costs include depreciation, interest, repairs, and twine for the binder and all labor and horse work (exclusive of grain hauling), and a charge for threshing based on rates used for custom threshing in 1927.

For 50 acres a year the cost of combining is considerably greater than is the cost of harvesting with a binder and hiring the threshing done with a stationary separator. For 100 acres a year the cost with a 10-foot combine is slightly less than with a binder, and for 150 and 200 acres there is a substantial difference in cost in favor of the combine.

In the Corn Belt and in the Eastern States the season for harvesting usually is not long enough to allow one binder to harvest more than 200 acres a year, whereas a 10-foot combine can harvest over twice as much.

For 50 acres a year the cost of combining with a 16-foot machine would be prohibitive. The cost of harvesting 50 acres a year with a binder and hiring the threshing done with a stationary thresher is considerably greater than the cost for the work if done by a header and separator, as the depreciation and interest costs for a header are about one-half of those for a binder. For 100 to 200 acres a year there is also a substantial difference in cost in favor of the header. A header can be used on acreages that do not run much over 300, but the binder should not be depended upon to harvest much over 200 acres yearly. For 100 acres a year the cost with a 16-foot combine is slightly more than for a binder and considerably more than for a header, but for 200 acres and more the difference steadily increases in favor of the combine.

The total charge for harvesting and threshing 275 acres, the average acreage harvested in 1927 with 10-foot combines in the Corn Belt, was about $1.95 per acre, as compared with about $3.64 per acre when the work was done by two binders and a hired separator. In cutting 640 acres with 16-foot combines in the Great Plains the cost was about $1.65 per acre, as compared with about $3.55 per acre when the work was done by three binders, and $3.13 for two headers and a hired separator.

Direct cash or out-of-pocket expenses, if the help of two men is available, amounts to 34 cents per acre for a 10-foot combine in the Corn Belt, as compared with $2.03 for harvesting with the binders and threshing with a hired separator; for the 16-foot combine in the Great Plains the out-of-pocket expenses would be 33 cents per acre as compared with $2.10 and $2.35 per acre, respectively, for the binders and headers when the threshing is done with a hired separator.

LENGTH OF HARVEST SEASON

Grain crops under all conditions are ready for harvesting with a combine about 7 to 14 days after they are ripe enough to be cut with a binder. The proportion of the time in which a combine will be used during any harvesting season is chiefly dependent on weather conditions, as harvest is seldom completed without some delay from rain. In addition to delays from inclement weather some time may be lost in waiting for or making repairs to the machine. The number of days available for cutting the crops on most farms is ample; yet some operators who harvest grain sorghums, flax, or soy beans may be pressed for time in which to complete their harvest. Wheat harvest also is sometimes delayed to the extent that combine operators have difficulty in completing harvest, as was the case in Montana in 1926. Such delay may also arise where grain is harvested with a binder, as in Illinois in 1926, where much of the small grain was lost or not threshed until the spring of 1927, because of excessive rains, but combine operators were able to complete their harvest before the rainy weather set in, thus saving their entire crop.

In the Great Plains wheat can stand in the field for three or four weeks after ripening, without loss, and in the Corn Belt wheat can stand two or three weeks, but in the East it should be cut within two weeks after ripening, so that harvesting will be completed before many of the plants have broken over.

As oats usually should be cut within four or five days after ripening in order to evade the breaking over of the stalks, the harvest season for this crop is limited.

Soy beans frequently are left in the field two or three months after ripening. They have been harvested with a combine successfully in midwinter. Stormy weather and slow drying of the crop in the fall serve to prolong soy-bean harvest longer than the harvest of any of the grain crops.

WEATHER CONDITIONS

Weather at harvest time is the most important factor in determining the acreage that can be harvested with a machine during a given period. The number of rainy days is not an exact indication of the delays caused in harvesting. A heavy rain causes only a slightly longer delay in combining than does a light rain, because the standing grain will absorb only a limited quantity of moisture and it dries rather quickly as soon as the weather clears. A rain of 2 inches or more usually delays shock threshing as long as it delays combining. A rain followed by cloudy weather may delay harvest several days, whereas a shower followed by a clear sky may cause little delay. Rains that occur in late afternoon may not interfere with harvest for more than a few hours. Intermittent rains occurring at harvest time may cause a loss of valuable time, the amount of time lost depending upon the duration and frequency of the rains and the stage of ripeness of the crop.

The average number and percentage of days during the small-grain harvest season on which rains of 0.1 inch or more occurred during a 13-year period are shown for several stations in Figure 6.

Humidity and dew, although of far less importance than rainfall during the harvest season, govern to some extent the time when harvesting can begin in the morning and will stop at night. Evaporation is greater and humidity is less in the Great Plains than in the Corn Belt or in the Eastern States. This would indicate that there would be more delay in harvesting after rains farther east than in the Great Plains. During periods of dry weather the humidity in the early morning is very similar in the Great Plains and in the Corn Belt. This would indicate that at times delays in starting combines in the morning would be but little greater in the Corn Belt and in the Eastern States than in the Great Plains region and probably no greater than in the northern spring-wheat area.

In certain areas most farmers feel that hail is their greatest risk at harvest time. There is an added risk when grain is harvested with a combine since the crop must stand 7 to 14 days longer than when it is cut with a binder. Hail is a much greater risk to crops in that portion of the Great Plains in which combines are now used extensively than in grain-growing sections east of the Mississippi River. In some sections fire is a greater risk than hail.

High and prolonged winds occurring when the grain is ripe and dry occasionally cause heavy shattering losses. Such losses may occur in any field, irrespective of the method of harvesting.

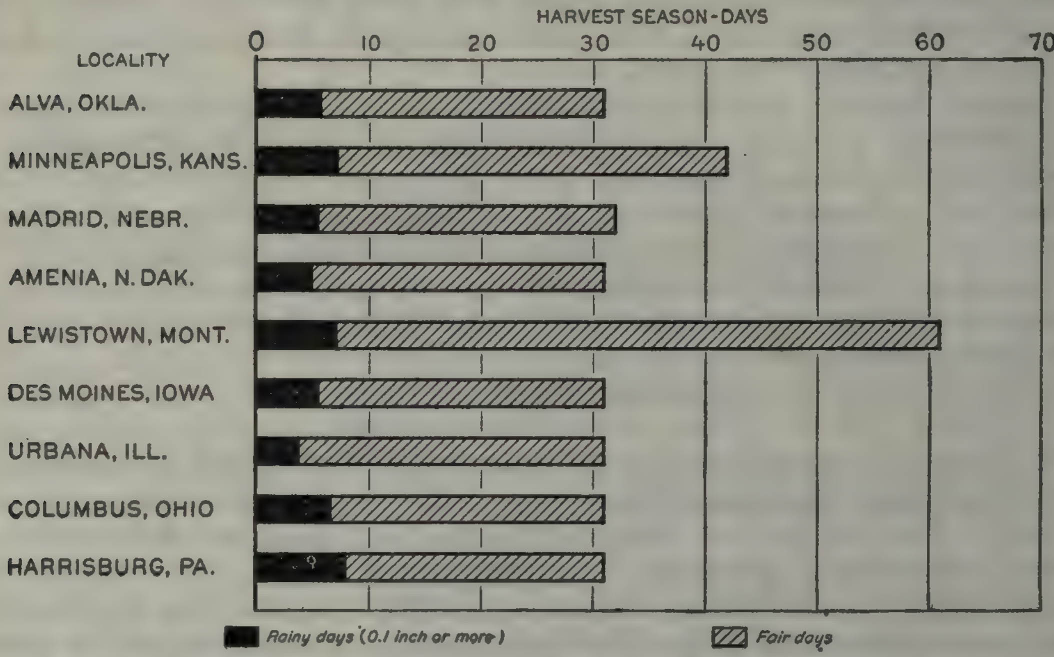

FIG. 6.—WEATHER CONDITIONS DURING HARVEST SEASON FOR SMALL GRAINS, AT NINE SELECTED STATIONS; AVERAGE FOR 1914 TO 1926, INCLUSIVE

The percentage of rainy days was highest in Pennsylvania and lowest in Montana and was lower in Illinois, Iowa, and North Dakota than in Oklahoma. The term "rainy day," as here used, means any day during which 0.1 inch or more of rain fell.

HARVESTING LOSSES

Losses resulting from different methods of harvesting and threshing show that under ordinary conditions the combine does a good job of harvesting and under favorable conditions the work it does compares favorably with that done with a binder or header.

The chief source of loss in harvesting grain with the combine is found in the heads which drop in front of the cutter bar or are thrown out by the reel. Some heads on short or lodged stems are completely missed by the cutter bar. Some combines allow considerable quantities of grain and heads to be thrown from the feeder box in front of the cylinder.

The losses occurring when winter wheat is harvested with combines in the Great Plains are practically all less than 3 per cent. Greater losses occur only in partly lodged grain, on rough land, with poor machines, with careless operators, or in very windy weather. In the Corn Belt and in the Eastern States harvesting losses are somewhat higher than in the Great Plains because more of the grain is lodged and because of greater interference from weeds.

The average loss in harvesting 190 fields of hard winter wheat with combines in the Great Plains in 1926 was 2.6 per cent, as compared with 3.3 per cent with headers and 6.1 per cent with binders. In South Dakota in 1927 the average losses in harvesting spring wheat were 1.8 per cent with combines, 2.7 per cent with headers, and 3.0 per cent with binders. In the Corn Belt the losses in harvesting with the combine and binder are about equal. East of the Corn Belt the losses in combining are similar to or slightly greater than those incident to harvesting with the binder because more of the grain is lodged during harvesting when the combine is used.

Losses in harvesting oats with the combine will exceed those with the binder unless the combining is done before the oat plants break over. The breaking over of the ripe stems is a serious handicap in combining oats.

The losses in harvesting soy beans with a combine are considerably less than those incurred in harvesting them by other methods.

When grain crops stand for several weeks after ripening the stems gradually weaken and break. Wheat and rye usually stand up longer than do oats and barley. Some thin-stemmed varieties appear to stand as well as thick-stemmed varieties. Damp weather appears to favor this breaking over; consequently the difficulty is confined largely to the Eastern States. Combines usually will cut the broken-over grain cleanly, but many heads may drop in front of the cutter bar. Harvesting a down crop is slower, and losses are greater because all of the straw must be threshed, and if legumes have been sown with the crop, the top of these plants may be cut off, or more weeds may be cut.

Weak-stemmed varieties of grain, which frequently lodge before maturity, are objectionable, no matter what method of harvesting is used. Combine operators agree that lodged grain can be harvested with a combine as well as, or better than, by any other method. The sickle guards on many combines curve downward and tend to lift the leaning and prostrate stems. The reel of a combine can be adjusted to lift up the lodged stems better than does a binder reel. As the crop is handled only once by a combine, some heads are saved which would be lost if the grain was bound.

Appreciable shattering of wheat seldom occurs in the Great Plains and is of rare occurrence under the more humid conditions in the East except when certain easily shattered varieties are grown. The hard red winter, hard red spring, and durum wheats of the Great Plains are not likely to shatter unless harvesting is much delayed or unless high winds blow.

THRESHING LOSSES

The average threshing losses from grain carried over with the straw are slightly larger with combines than with separators. These losses are due chiefly to the inexperience of combine operators, although in weedy and lodged grain certain threshing losses in combining are unavoidable. Under ordinary conditions good clean threshing is just as easily accomplished with a combine as with a separator. Many combine operators do excellent threshing. The chief threshing losses are from grain blown out over the rear of the machine by too strong a blast of air or carried over with thick layers of chaff and weeds. These losses can be greatly reduced by proper adjustment and operation. Combines can also be adjusted to thresh the grain from the heads almost completely even when the straw is tough and the grain too damp for safe storage. Losses from grain left in the heads seldom exceed 0.5 per cent.

WEEDS

Numerous green weeds such as sunflowers, wild sweet potatoes, mustard, Russian thistle, ragweed, smartweed, and milkweed, also large sweet-clover plants, greatly interfere with combine threshing as they choke the machine, carry over grain, and increase the moisture content of the grain. Large mature weeds of certain kinds sometimes choke the reel or cutter bar. Weeds are most troublesome in wet seasons, when harvesting is delayed and the crop is broken over. Weeds which are not tall enough to be cut by the cutter bar do not interfere with combining. If grain crops are cut with the binder the weeds dry before threshing and no moisture is absorbed from the weeds or weed seeds by the grain.

QUALITY AND CONDITION OF COMBINED GRAIN

The average moisture content of combined grain usually is higher than in grain threshed from the shock.

The average moisture content of 40 samples of wheat combined in Indiana in 1927 was 15.7 per cent, as compared with 14.4 per cent in seven samples threshed from the shock. In South Dakota, where the harvest season was damp, the combined wheat averaged 17.7 per cent moisture and the shock-threshed wheat 13.1 per cent. In 1926 in the Great Plains the moisture content of combined wheat was about 2 per cent more than in shock-threshed wheat. Wheat usually should contain not more than 14 per cent moisture in order to keep in storage.

Inexperienced combine operators frequently harvest when the grain is too damp. Experienced operators, on the other hand, are more inclined to wait until the crop is fully ripe before beginning to harvest, and they allow the crop to dry after each rain before resuming harvesting. If combine harvesting is postponed until the crop is in proper condition there will be little danger of the grain spoiling in storage. The moisture content of damp wheat or other grain standing in the field frequently drops 3 to 4 per cent in a day if the weather is dry and clear and the humidity is low. Combined grain is accepted at the local markets at the same price as grain threshed from the shock or stack if it has been harvested at the proper time.

Damp grain either must be dried by being spread out or by being put through an artificial grain drier, or it must be mixed with dry grain in order to keep it from going out of condition. As most of the grain driers are located at the terminal markets, only a limited quantity of damp grain can be handled at the local elevators. Economical grain driers for use on the farm have not yet been developed, and ventilated bins are not effective in drying grain which is distinctly damp. Grain can be dried by being spread in a thin layer on a barn floor and frequently stirred, but this method of drying has its limitations.

Most of the combined soy beans have contained less than 14 per cent moisture and have been drier than those harvested by other methods.

SAVING THE STRAW

The straw from combines usually is scattered on the land with straw spreaders or is merely dropped in windrows from the rear of the machines. Some combines are equipped with straw bunchers which drop the straw and chaff in piles. Sometimes the straw and stubble are burned in order to facilitate plowing. Most of the straw from threshing machines in the West is wasted, although some of it is returned to the land as manure. Consequently there is a greater addition of organic matter to the soil in combine harvesting than in harvesting by any other method. Straw is more evenly distributed with a straw spreader on a combine than by any other method.

Straw from combines can be saved by being gathered from windrows with a hay loader, or by the bunches being loaded by hand or by a sweep rake and baled in the field. Farmers sometimes harvest a part of their crop with a binder and thresh the bundles with the combine in order to save some straw for feed and bedding. A few farmers cut their grain as high as possible with a combine and cut the stubble later with a mower.

When a legume has been sown with a grain crop and the grain is harvested with a combine the following hay crop will be mixed with decayed straw. The straw that is left usually is not heavy enough to smother the young legume plants and may even prove a protection. There is less clipping of the legume crop with a combine than with a binder because the stubble is cut higher.

ACREAGE ON WHICH A COMBINE WILL BE ECONOMICAL

Many combines are bought for use primarily on the home farm, but some are bought with the idea of doing additional work for others as a means of partially paying for the combine. The minimum acreage for which a combine will be profitable is determined largely by the cost of alternative methods of harvesting. The acre cost is less for a large than for a small acreage.

In the Corn Belt, where the cost of labor is less than in the Great Plains, there should be about 80 acres for a 10-foot combine before the cost of combining will be less than the cost of harvesting with a binder and threshing with a stationary separator. On the basis of the cost of operating in localities of the Great Plains in which binders are used in preference to headers, an operator may find his harvest costs decreased by a 10-foot combine if he has 60 acres or more of grain to cut. With a 15-foot machine a farmer must have at least 100 acres before the costs will be less than when harvesting is done with a binder. The minimum acreage that justifies a combine in localities in which it is customary to use headers would be about 100 for the 10-foot and at least 160 acres for the 15-foot machine.

In Illinois and Indiana the operators' estimates of the least acreage of all crops for which a combine would be profitable were about 150 acres for the 8-foot, 170 acres for 9-foot, 180 acres for 10-foot and 300 acres for the 12-foot machines. The average of estimates made by 220 farmers in the Great Plains as to the least acreage for which it would be profitable to own a combine ranged from about 130 acres for the 8-foot machines to 400 acres for the 20-foot machines. If the combine is used each year for some custom work the acreage of owned grain necessary for profitable operation of the combine would be smaller than either the computed figure or the estimate of the operators. In most cases the owners who made these estimates were considering points other than the difference in cost of harvesting by combines and by other methods. Some of the points which these operators considered were as follows: The first cost of the outfit, money available to pay for it, use of the combine for custom work, power requirements, salvage value and age of present harvesting equipment, and the supply of family labor.

The combine can be used in small fields as well as in large ones. The machines can turn a square corner within the space of the previous swath. A tractor-drawn combine usually turns a corner more quickly than does a horse-drawn binder or mower. The only disadvantage which a combine has in small fields in comparison with a binder is that more grain is crushed down on the first round. The smaller the field the greater the proportion of the crop that is lost in this way. If the grain in the borders of the field is cut previously with a binder or mower, a common practice even in large fields in the Pacific Northwest, no grain will be crushed down on the first round of the combine.

Combines are now built with an over-all width from 8 to 19 feet when arranged for transporting. Nearly all models will pass through a 16-foot gate. As it is usually easier to build wide wire gates than to prepare a combine for transport repeatedly, on many farms in the Corn Belt and in the Eastern States wider gates will have to be provided or sections of fence will have to be taken down to permit the easy moving of combines.

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U. S. DEPARTMENT OF
AGRICULTURE
FARMERS' BULLETIN No. 1566

Revised Apr. '41

THE SORGHUM MIDGE
with suggestions for control

1862 1889

THE SORGHUM MIDGE costs American farmers a loss of millions of dollars every year in the damage which it inflicts on the grain sorghums, and great losses also in the seed crops of other sorghums, broomcorns, and Sudan grass. The larvae of this insect damage the crop by consuming the plant juices of the developing seeds. The egg is laid in the spikelet of the host plant, and remains there next to the seed while developing through the intervening stages to maturity. Insecticides have not been found practicable for controlling this pest, as there is no known manner of applying them within the seed husks. This bulletin contains instructions for reducing the losses caused by it, and lessening or avoiding infestation.

Washington, D. C. **Issued September, 1928**

THE SORGHUM MIDGE, WITH SUGGESTIONS FOR CONTROL

By C. H. GABLE, formerly *Associate Entomologist;* W. A. BAKER, *Associate Entomologist;* and L. C. WOODRUFF, *Junior Entomologist, Division of Cereal and Forage Insects, Bureau of Entomology*

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IMPORTANCE OF THE MIDGE AND NATURE OF THE INJURY CAUSED BY IT

THE SORGHUM MIDGE[1] is by far the most important insect attacking the grain sorghums. With an annual farm value of about $100,000,000 these crops suffer an average loss of millions of dollars annually through the ravages of this insect. Besides the damage to the grain sorghums great losses from this cause occur in the seed crops of the sweet sorghums, Sudan grass, and broomcorns. In many sections where the sorghum midge is especially abundant a yearly loss of approximately one-fifth of the crop occurs, while in years particularly favorable to the midge these sections produce practically no grain whatever.

The injury caused by the sorghum midge consists in the "blighting" or "blasting" of infested grain. The larvae extract the plant juices from the developing seeds, thus causing them to shrivel and dry. The affected grain, or seed, becomes shrunken and sometimes discolored, giving the infested spikelet an appearance of sterility. The injuries popularly known as "blast" or "blight" may in some cases be due to other causes, but in most instances such injuries are the result of infestation by the midge.

DISTRIBUTION OF THE MIDGE AND PLANTS WHICH IT ATTACKS

The sorghum midge is now well established throughout the principal sorghum-producing sections of the United States. (Fig. 1.) Although serious losses occur in the Central and Eastern States, the greatest injury from this pest is found within its range in the Gulf States.

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[1] *Contarinia sorghicola* Coq., order Diptera, family Itonididae.

No variety of sorghum has yet been found that is resistant to the attacks of the sorghum midge. This insect infests with equal readiness all varieties of the grain sorghums, sorgos (sweet sorghums), broomcorn, Johnson grass, Sudan grass, and tall redtop,[2] the last being a wild grass found plentifully in many of the Southern and Eastern States. It is believed that the midge also breeds on other kinds of wild grasses.

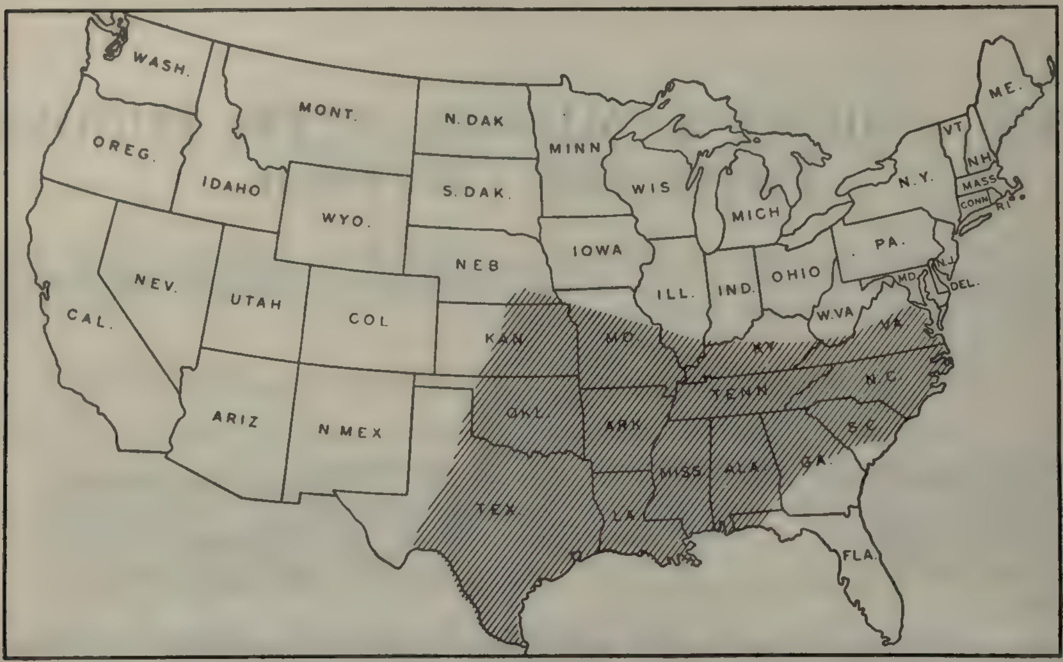

FIG. 1.—Map showing by the shaded portion the known distribution of the sorghum midge in the United States

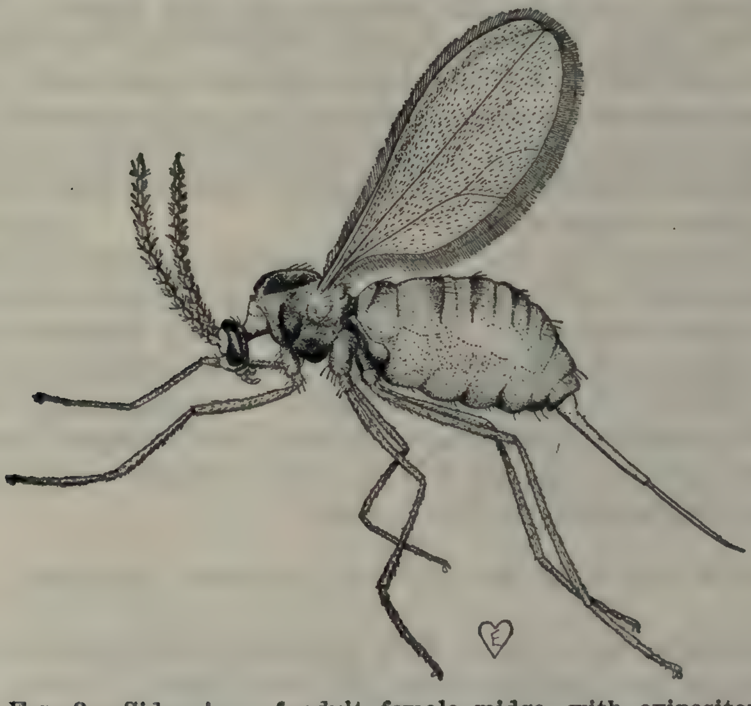

FIG. 2.—Side view of adult female midge, with ovipositor extended. Enlarged 20 diameters

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[2] *Triodia flava* (L.) Hitchc.

LIFE OF THE MIDGE

If the heads of any of the previously mentioned host plants are examined while in bloom, many small, reddish, gnatlike flies or midges may be found crawling actively over the spikelets of these heads. The flies are the adult females (fig. 2) of the sorghum midge, which are busily laying their eggs within the flowers of the heads. About two weeks later the male flies of these insects have come out and may be found swarming around the same heads awaiting the emergence of the females.

Each female lays approximately 100 tiny white eggs (fig. 3), attaching them to the inner wall of the glumes, or what will become the seed husks. Although not more than one egg is deposited at a time in a given spikelet, it is not uncommon for several females to follow one another in quick succession, in laying eggs within the the same spikelet.

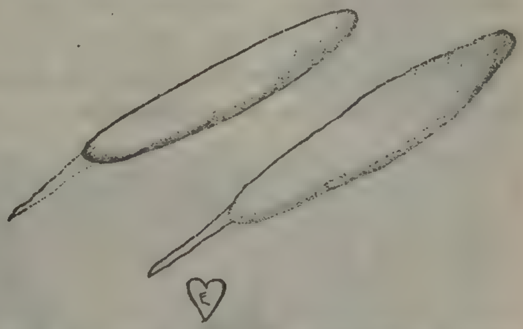

FIG. 3.—Eggs of the sorghum midge. Enlarged 200 diameters. Note the "stem" by which they are attached to the blossom

These eggs hatch in two days, and the resulting small, grayish, maggotlike larvae (fig. 4) establish themselves close to the developing grain and from this they extract their food. When feeding begins the larva turns a pinkish color, which deepens with growth, until at the time of pupation it is a distinct red. The portion of the ovary in contact with the larva shrinks, and the larva is partially enveloped in the resulting shallow, irregular depression. An infestation of one larva per spikelet is sufficient to cause complete loss of the grain (fig. 5, B) but as many as 8 or 10 larvae may develop to maturity on the same seed. The larvae become full grown and pupate in from 7 to 11 days. When newly formed, the pupae (fig. 6) are uniformly red, but the head and appendages soon turn to a dark brown or black. The adults or midges are ready to emerge from the pupal stage at the end of three days. At this time the pupa works its way to the tip of the spikelet, where the skin splits and the adult is liberated. Mating occurs soon after emergence and the females fly to the nearest heads suitable for oviposition. The adults live about two days.

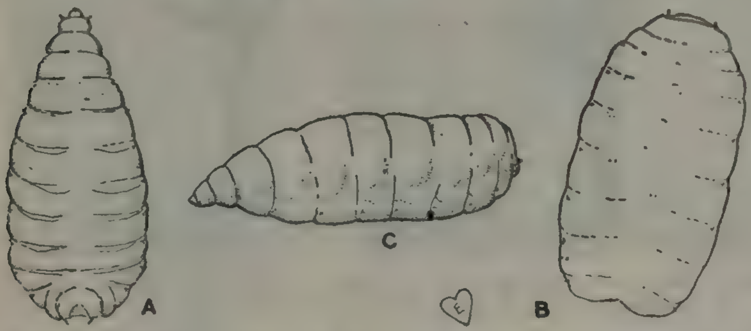

FIG. 4.—Larva of the sorghum midge. A, dorsal view of midge, with proboscis extended; B, same, with proboscis retracted; C, side view. Enlarged 12 diameters

Under normal summer temperatures from 14 to 16 days are required for the complete life cycle. This time varies with the temperature, and is longer in the earlier and later parts of the season, or during cool spells in summer.

SEASONAL HISTORY

The adult flies of the sorghum midge first appear early in the spring at about the time that the Johnson grass and other wild host plants begin to bloom, and in the heads of these plants they lay their first eggs. The flies continue well into the summer to emerge from hibernation. The greatest emergence occurs at about the time the early crop of sorghum is blooming. Where host-plant heads in a suitable condition for oviposition are limited, the females concentrate on these heads and an extremely heavy infestation results. This is true of the earliest blooming host plants in the spring and also of the earliest blooming heads in cultivated sorghums. Throughout the season the female midges lay their eggs very actively and may be found doing this on the flowering heads of any available host plants.

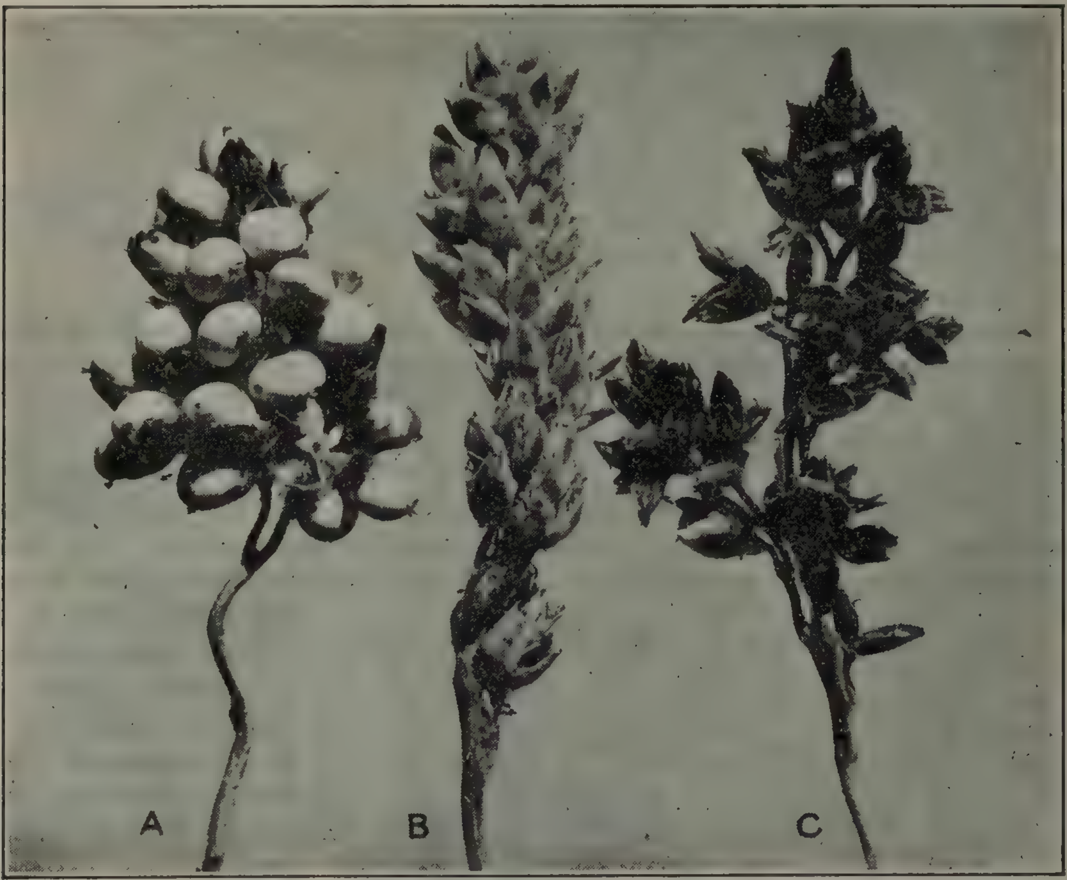

FIG. 5.—Spikelets of sorghum heads. A, normal; B, severely injured by the sorghum midge; C, injured by birds. Slightly enlarged

Successive life cycles occur throughout the season from the first emergence of hibernating individuals in the spring until the host plants are killed by freezing in the fall. These cycles overlap to such an extent that no well-defined broods are apparent, and all stages of development may be found in the field at any time. One or two cycles usually occur on the volunteer or wild hosts in the early spring, before the cultivated crops bloom.

The midge hibernates as a larva within a puparium in Johnson grass or other host plants. (Fig. 7.) The puparium is brown and resembles the small cocoons of some other insects, owing to the fact that débris from the spikelet of the host plant adheres to it. As the summer progresses a few of the larvae develop into the hibernating form, but with no apparent regularity. In the fall, however, a larger number of larvae form puparia. Most of the hibernating or overwintering larvae change to pupae and emerge as adults in the following spring, but many of them delay emergence until the second or third spring.

NATURAL ENEMIES

Birds, spiders, and insects play their part in keeping the sorghum midge in check. In localities where the midge is plentiful large numbers of spiders are found on the sorghum heads, and more than 20 species have been observed feeding upon adult midges.

The Argentine ant[3] and the small fire ants[4] destroy many midges by swarming over the sorghum heads and seizing the pupae which protrue from the spikelets. They also attack the newly emerged adults before these are capable of flight.

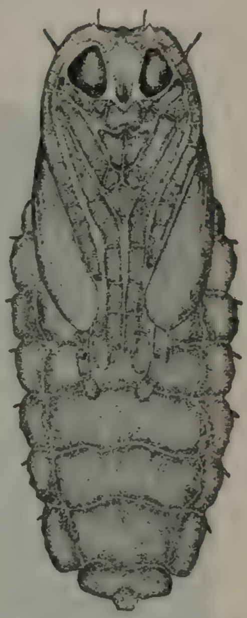

FIG. 6.—Ventral view of pupa of the sorghum midge. Enlarged 34 diameters

Three tiny wasplike parasites are commonly found associated with the sorghum midge, feeding upon the larvae and pupae. These parasites multiply rather slowly in the spring and only in the latter part of summer do they materially affect the amount of damage inflicted by the midge upon the crop.

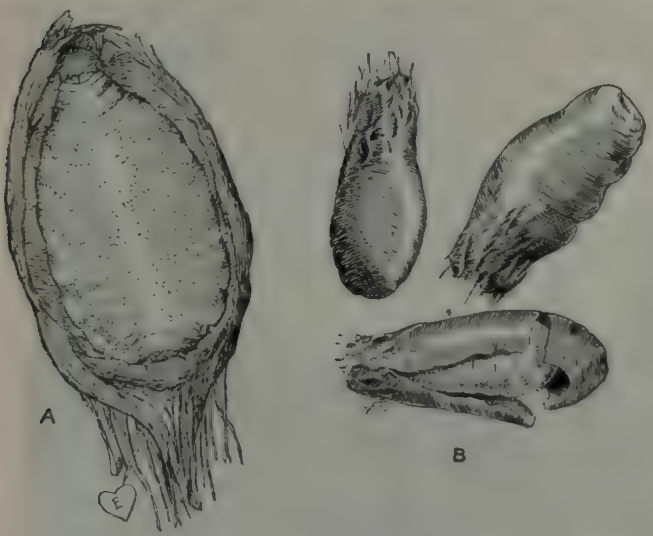

FIG. 7.—A, larva of sorghum midge within its cocoon, enlarged 12 diameters; B, exterior views of cocoons, enlarged 7 diameters. A, original; B, after W. H. Dean

IMPORTANT FACTS BEARING ON CONTROL

The most important factor affecting the amount of damage by the sorghum midge is the source of infestation. No serious injury to a field of sorghum can occur unless there is a near-by source from which an influx of female midges may come.

Johnson grass serves as a prolific source for the infestation of near-by fields. (Fig. 8.) When allowed to head, this grass provides an excellent place for hibernation. It blooms very early, thus permitting the individuals first emerging to increase their numbers materially before the sorghum fields come into bloom. Midges continue to breed throughout the season in Johnson grass, thereby making it a constant source of infestation to blooming sorghum fields. (Fig. 9.) The same is true, although probably to a lesser degree, of the wild grass known as tall redtop, previously mentioned.

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[3] *Iridomyrmex humilis* Mayr.

[4] Species of Solenopsis.

Infested sorghum fields from which midges are emerging are serious sources of infestation to adjacent fields when the latter are in bloom.

FIG. 8.—Early Johnson grass, patches of which are known to harbor the sorghum midge

Volunteer and early-blooming host plants may develop in a field some time before the main crop comes into bloom. These early heads are usually heavily infested and may become an important source of infestation to the remainder of the field.

FIG. 9.—Fence line bordering a sorghum field and allowed to become grown up with Johnson grass

Adult midges migrate for a considerable distance from an infested source to the blooming host plants, especially with the help of the wind, which is an important factor in the dispersion of the adults over near-by fields. Practically all flight is in the direction of the prevailing winds.

RECOMMENDATIONS FOR CONTROL

Owing to the fact that all stages of the midge, with the exception of the adult, are passed within the seed husks, there are at present no practical means of controlling it by the use of insecticides.

TO REDUCE LOSSES

The loss of grain in sorghum fields, due to the midges which come into them from outside sources, can be much reduced by putting into effect the following recommendations:

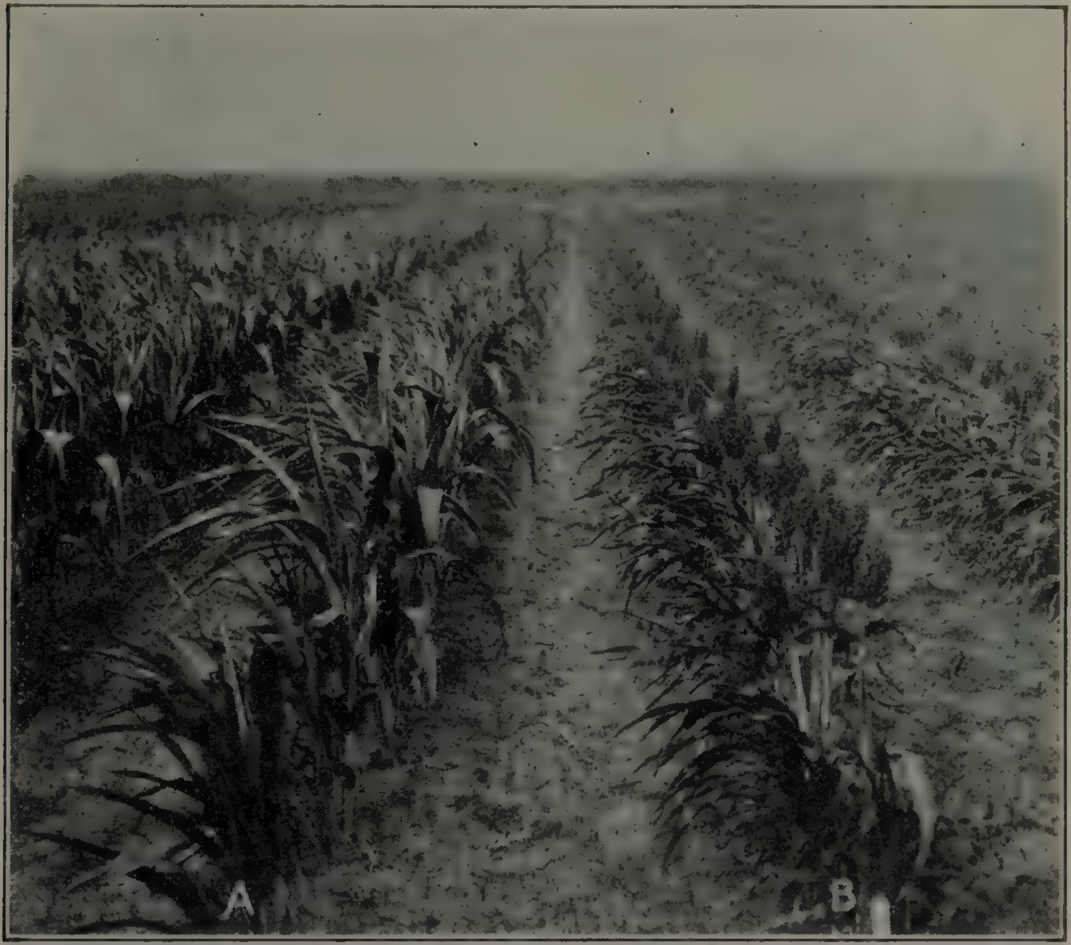

FIG. 10.—Rows of different varieties of grain sorghum. A, a row of plants upon which heads have not yet emerged. B, a row of plants fully headed out and exposed to attack by the sorghum midge

Locate the field as far as possible from all outside sources of infestation, such as Johnson grass, old sorghum fields, broomcorn, and Sudan grass.

Locate the field so that the prevailing wind blows from the field to be protected toward the most probable source of infestation.

Plant the field at such a date that it will bloom either before or at about the same time as the fields from which infestation is expected or after emergence of midges has ceased in them. (Fig. 10.)

Prior to the development of the grainfields which it is desired to protect, destroy any near-by heads, such as those of volunteer sorghum or wild-grass host plants.

TO LESSEN INFESTATION

The increase in numbers of midges within the sorghum field, owing to successive generations made possible by a long blooming period, may be controlled by the following practices:

Plant only one variety of host plant in the field.

Practice any farm measures which will help to produce a sturdy crop, uniformly developed. A good seed bed should be thoroughly prepared and the best quality of seed of pure strain planted. The date of planting should be such as is considered best for the development of the crop, and the seed should be spaced so as to insure a good stand and to prevent excessive tillering and lack of uniformity in the development of the heads.

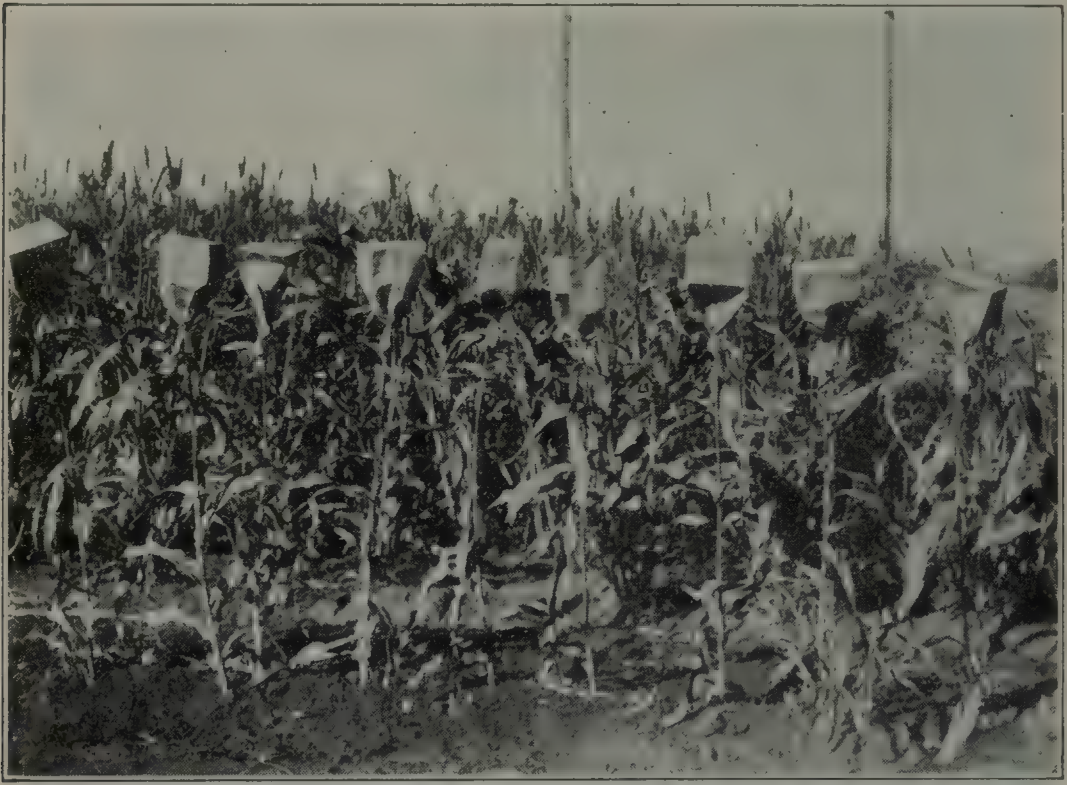

FIG. 11.—Heads of sorghum seed, temporarily covered with paper bags for protection from the sorghum midge

A few days before the main crop blooms, cut all heads of sorghum in the field that are in bloom, or past bloom, remove them from the field and destroy them. This operation will be reduced to the minimum if the previous suggestions as to the use of pure seed and cultural methods have been observed.

Do not allow Johnson grass to form heads in the grain-sorghum field before the sorghum plants bloom and, wherever practical, eliminate it entirely from the farm.

TO AVOID SPRING INFESTATION

Spring emergence of hibernating individuals may be reduced by the following practices:

Burn over the Johnson-grass fields and waste places during the winter months. This will destroy many of the larvae in hibernation.

After harvest rake up and destroy all loose heads in the field.

If the grain is threshed, burn up all refuse that has not been fed to stock by spring.

Small crops of seed can be obtained by tying paper bags over the heads of selected host plants during the blooming season, thus protecting the heads from infestation by the midge. (Fig. 11.) These bags have no effect upon the development of the seed. They may be placed on the heads as soon as the latter are out of the boot, but should be removed shortly after the blooming period, as they produce conditions favorable to the development of the various worms which attack the grain heads.

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September 7, 1928

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1567

PROPAGATION OF TREES AND SHRUBS

THIS BULLETIN describes briefly some of the methods frequently employed for the propagation of deciduous fruit trees as well as a number of the trees and shrubs used for the adornment of home grounds. Practical details concerning the care and handling of tree seeds, the culture of seedlings, the successive steps in the handling of cuttings, layers, grafts, and buds in order to succeed in these operations, as well as the methods of propagation most suitable for the several different kinds of woody plants, are presented.

Washington, D. C. Issued April, 1929

PROPAGATION OF TREES AND SHRUBS[1]

By **Guy E. Yerkes**, *Horticulturist, Office of Horticultural Crops and Diseases, Bureau of Plant Industry*

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INTRODUCTION

IN NATURE woody plants reproduce their kind most frequently by seeds; they also reproduce by root sprouts or suckers and by layers. By such means species or general types are perpetuated and increased. In addition to these, man has developed propagation by the use of cuttings, as well as grafts and buds, to reproduce peculiarly desirable qualities found in a single individual and to multiply the number of such individuals.

Since ancient times man has employed grafts and cuttings as well as the means of propagation more commonly met in nature. The ancient methods, modified and improved by successive generations, constitute the foundation on which is based the present-day culture of trees in the nursery. Some of these operations have become more or less standardized, although they must frequently be altered to meet the widely different conditions under which trees are grown.

Besides actual propagation, many details enter into the preparation of trees to fit them for permanent planting. Cultivating, transplanting, pruning, control of diseases and insects, and other operations must also be given attention, in order to obtain vigorous growth with well-developed roots and properly formed tops. An intimate knowledge of these details, which can be had only by special training and experience, is essential to the efficient production of high-grade trees. Hence the ordinary planter usually depends on the nurseryman equipped for quantity production to supply his trees. There is no reason, however, why anyone with a general knowledge of trees can not propagate them, provided he will learn the easily under-

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[1] Manuscript submitted to the chief of the bureau Sept. 21, 1927.

stood manipulations and give the plants the necessary care and attention.

The most appropriate means of propagation depend on the kind of plants, the use for which they are intended, the facilities which are available, and other circumstances.

Seeds very often offer the readiest and least expensive means for the reproduction of species. Seedlings, however, usually vary more or less in their characteristics; hence dependence can not be placed on them to furnish plants which are exact reproductions of their parents.

Cuttings are used to reproduce like plants of many varieties of ornamentals, also some of the fruits. For practical purposes the plants so reproduced are similar in all respects to the mother plants, although bud variants or "sports" appear occasionally.

Layers are useful in propagating many woody plants, especially when only a small increase is required. In ordinary nursery practice, however, layering is too slow a process except for certain classes of plants which are not easily propagated by other means.

Suckers, or shoots originating from the roots or the stems of the plants below ground, are used to a limited extent. Comparatively few species form such shoots freely enough to make a rapid increase possible by this means.

Grafting and budding are means extensively employed for the propagation of varieties that do not root easily from cuttings.

PROPAGATION BY SEEDS

Under conditions in the wild, most woody plants are dependent in large measure upon seed for their reproduction. Falling from the trees the seed is covered by leaves or scattered by the wind to drop in moist soil or in crevices; it is floated down streams and left in the mud on the banks; it is frequently carried many miles by birds. Large seeds, such as acorns and nuts, are often buried by squirrels in places where the conditions are favorable for germination.

Much can be learned about the principles of caring for tree seed in the nursery by observing conditions under which it germinates and grows in the wild. Often these natural conditions can be imitated and improved by the various artificial aids designed to give protection to the seeds and seedlings as well as to provide suitable conditions for germination and growth. Nature is extravagant with seed, whereas the desire of the propagator is to produce the largest number of good seedlings with the minimum amount of seed and labor.

The first necessity is fresh seed of good germinating quality. If seed-bearing trees of the desired species are growing near at hand, they are usually the best source of supply. When collecting seed, it is advisable to examine a number of seeds from each tree by cutting them open to see if the kernels are plump before expending labor on gathering them. Close observation of the various species must be made to determine when the seed is ripe. If not harvested at the right time it is likely to be scattered from the seed vessels or otherwise lost.

The maturity of the seed of conifers usually can be determined by cutting open the cones from time to time. As the seed matures, the outer coat changes to brown and the seed itself loses its milky state and becomes firm. Seeds having a more or less pulpy covering, such as hawthorn, rose, plum, and the like, are usually ready to collect when the fruits are well colored. Often such seeds can be cleaned by mashing the outer coats and placing the mass in water for two or three days to soften the pulp. When separated, the good seed settles to the bottom of the container and the pulp and light seed afloat can be washed off.

When seeds are not procurable from near-by sources dependence must be placed on collectors and dealers from a distance. Large growers of seedlings give much attention to locating the best sources of seed and making contacts with collectors. Smaller users are dependent largely upon dealers in tree seed. This branch of the seed business is an important one represented by a number of firms which issue catalogues offering a wide variety of seed of trees and shrubs.

STORAGE OF SEEDS

The proper care of tree and shrub seeds during the interval between the time of collecting and that of planting is a matter of importance which frequently is overlooked. Some conifer seed, such as pine, spruce, and arbor vitae, keeps in good condition after drying if stored in tightly covered containers or in paper bags where the air is dry and cool and away from mice. Seeds of other conifers and of some of the important species of deciduous trees and shrubs grown for ornamentals are injured by drying and should be placed in cool, moist storage within a short time after gathering. When seeds are to be procured from a distance it is advisable to place the orders before the time of harvesting, so that they may be received without unnecessary delay and placed at once under favorable conditions to prepare them for germination.

Some kinds of seed will not germinate when they are collected, but require a period of several months for the complex internal development called "after ripening." Some complete this process during the winter if planted in autumn or kept moist at a temperature a few degrees above freezing and will germinate the following spring; others, as some species of dogwood, hawthorn, holly, juniper, viburnum, and yew, may require a longer period and sometimes refuse to germinate until the second spring.

To store seeds and prepare them for later sowing, the most common way of providing constant moisture is stratification. Moist sand and seeds are placed in shallow boxes in alternating layers from one-half to 1 inch deep, depending on the size of the seed. (Fig. 1.) The boxes containing the sand and seeds are kept in a cool cellar, preferably between 35° and 45° F., where the sand will remain moist, or are buried in a well-drained place, or the container is set on top of the ground and covered with some material that will retain the moisture. Mice and rats are very fond of some kinds of tree seeds, and these pests must be guarded against by covering the tops of the boxes with wire screen or in some other effective way.

Instead of placing the seed between alternating layers of sand, the same results can be obtained by simply mixing the seed with about three or four times its volume of sand to aid in maintaining proper moisture and to prevent the seed from massing together in such a manner as to cause heating. Too much or too little moisture may injure its vitality.

Another method to provide moist storage and at the same time protect the seed from rodents is by the use of flat envelopes made of ordinary galvanized fly-screen wire in which the seed is spread out in a layer about 1 inch thick. These packages may be laid on top of the ground and covered to prevent severe freezing, or they may be put away in boxes with sand around them in a cool cellar. Seed kept moist in this manner should be examined frequently in early spring for the first signs of germination, as some, such as the apple, become active with the first warm days. Once germination begins, the seed must be planted immediately.

Imported apple, pear, cherry, and plum seed usually arrives during fall or winter. When received, it should be soaked for three or four days in fresh water, changing the water each day, and then stratified. It is also kept in large quantities, in burlap bags, in layers 2 to 3 inches thick, between cakes of ice.

Some seeds having hard, bony coats such as locust (Robinia and Gleditsia), yellowwood (Cladrastis), and Kentucky coffee tree (Gymnocladus), should have boiling hot water poured over them and then should be allowed to soak for a day. Those that swell will then be ready to plant; those that remain unchanged should be treated a second time. By this treatment, quicker and more uniform germination may be obtained than if the seeds are planted dry.

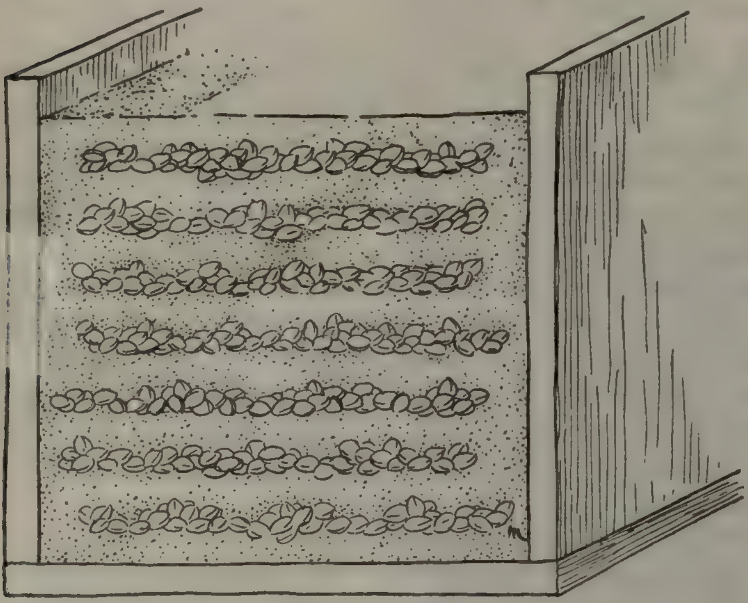

FIG. 1.—Cross section of box of stratified seed

Peach and apricot pits usually germinate well if stored moist and subjected to freezing, which helps to loosen the sutures. Freezing is not essential, however. In the Southern States good results are obtained by keeping considerable moisture around the pits from the time they are collected and storing them in a cool place, or by planting them as soon as possible after collection.

The following seeds may be stratified as soon as procured and planted in fall or early spring:

Apple (Malus).
Apricot (*Prunus armeniaca*).
Ash (Fraxinus).
Barberry (Berberis).
Beech (Fagus).
Bittersweet (Celastrus).
Boxwood (Buxus).
Cherry (Prunus).
Cork tree (Phellodendron).
Cotoneaster (Cotoneaster).
Cranberry bush (Viburnum).
Dogwood (Cornus).
False indigo (Amorpha).
Firethorn (Pyracantha).

Flowering quince (Cydonia).
Fringe tree (Chionanthus).
Hackberry (Celtis).
Hawthorn (Crataegus).
Holly (Ilex).
Honeysuckle (Lonicera).
Hornbeam (Carpinus).
Horse-chestnut (Aesculus).
Juniper, red cedar (Juniperus).
Linden (Tilia).
Locust (Robinia and Gleditsia).
Magnolia (Magnolia).
Maidenhair tree (Ginkgo).
Maple (Acer), species that ripen in fall.
Nandina (Nandina).
Papaw (Asimina).
Peach (Amygdalus).
Pear, French (*Pyrus communis*).
Pearlbush (Exochorda).
Persimmon (Diospyros).
Plum (Prunus).
Privet (Ligustrum).
Russian olive (Elaeagnus).
Shadblow (Amelanchier).
Siberian pea tree (Caragana).
Silver-bell (Halesia).
Snowbell (Styrax).
Sweet gum (Liquidambar).
Tulip tree (Liriodendron).
Yellowwood (Cladrastis).
Yew (Taxus).

Seeds which may be kept dry and planted in spring are:

Althaea (*Hibiscus syriacus*).
American arbor vitae (*Thuja occidentalis*).
Bald cypress (Taxodium).
Bluebeard (Caryopteris).
Catalpa (Catalpa).
Cedar (the true cedar) (Cedrus).
Chaste tree (Vitex).
Crape myrtle (Lagerstroemia).
Cryptomeria (Cryptomeria).
Cypress (Cupressus and Chamaecyparis.)
Hemlock (Tsuga).
Larch (Larix).
Mock orange (Philadelphus).
Mulberry (Morus).
Oriental arbor vitae (*Thuja orientalis*).
Pear, oriental species (*Pyrus calleryana* and *P. ussuriensis*).
Plane tree (Platanus).
Redbud (Cercis).
Sophora (Sophora).
Spruce (Picea).
Sweet shrub (Calycanthus).
Umbrella pine (Sciadopitys).
Wisteria (Wisteria).

These seeds should be planted as soon as ripe:

Birch (Betula).
Elm (Ulmus).
Maple (Acer), species that ripen in spring.
Oak (Quercus).

CONIFEROUS SEEDLINGS

SEED BEDS FOR CONIFERS

A fairly level site which is well drained is essential for a seed bed for conifers, and if possible it should be protected from strong wind. Good seedlings can be grown in almost any fertile soil, but rich, mellow, sandy loam is preferable because it is easy to work and holds moisture near the surface. Thin gravelly soils should be avoided for seed beds. Clay soil can be greatly improved by working sand into it. It may be desirable to begin the preparation of the soil a year or more in advance by applying manure a sufficient length of time before planting so that it becomes well rotted and thoroughly incorporated into the soil, also by plowing under cowpeas or clover to add fertility and to improve its physical condition. Some of the future expense of weeding can be saved by cultivating the land in advance, to rid it of weeds. Beds 4 feet wide with 2-foot paths between them and of any length are desirable for conifers, as such beds are convenient for working. In final preparation the beds should be spaded or plowed deeply, all roots and stones removed, the soil pulverized and then carefully leveled. Under most conditions some provision for watering the young seedlings is necessary, as they must not be allowed to become dry.

SHADING

Protection from full sunlight is usually necessary for best results in the seed bed, as conifers are easily injured by too much heat. Both low and high types of shading structures are in use, each having its advantages and disadvantages. An inexpensive and fairly satisfactory means of shading is provided by lath frames 3 by 4 feet, with open spaces between the laths. To support these frames a line of stakes 18 inches high and 6 feet apart is put along each edge of the beds. Over each line of stakes a No. 12 wire is stretched. Such a temporary shading is an advantage in that the location of the beds can be changed easily for each crop. (Figs. 2 and 3.)

A more permanent type of structure with laths or other strips supported on a high frame, although more expensive, provides excellent conditions for the seedlings and is very convenient while caring for the young plants. Such a structure is shown in Figure 4.

The amount of shade most desirable varies with different climatic conditions and species. In many situations screens made of ordinary building laths spaced 1½ inches apart are satisfactory.

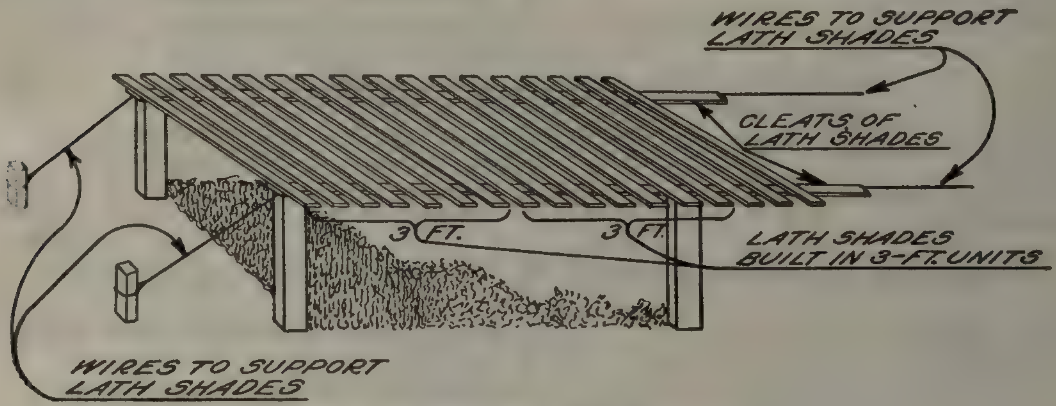
WIRES TO SUPPORT LATH SHADES
CLEATS OF LATH SHADES
3 FT.
3 FT.
LATH SHADES BUILT IN 3-FT. UNITS
WIRES TO SUPPORT LATH SHADES

FIG. 2.—Lath shade over seed beds

TIME OF PLANTING

Both fall and spring sowing are practiced for different species of conifers. In the Southern States fall planting is often desirable for such evergreens as Italian cypress and Chinese arbor vitae. Pines, spruces, arbor vitaes, hemlocks, and many others are more commonly planted in spring, particularly in the Northern and Central States. Red cedars, junipers, yews, and others for which stratification is recommended while the seed is in storage may be planted either in fall or in early spring.

PLANTING

The seed may be sown either broadcast or in rows. Broadcast sowing is usually preferred. The young plants often do best when growing in rather dense stands of 75 to 150 per square foot, the best number depending on the species and whether they are to remain in the seed bed more than one season. To obtain this stand it is necessary to sow the seed thickly. Experiments have shown that even when fresh seed is planted under very good conditions, only one-half to two-thirds as many seedlings may be expected as there were seeds sown. After sowing it is desirable to press the seed with a roller or packer to bring it into close contact with the moist soil and to aid in securing a uniform cover. A depth of covering equal to twice the diameter of the seeds is a fairly safe rule to follow in planting tree seeds in beds. Sand or sandy soil is preferable to heavy soil for covering.

During the period between sowing and actual sprouting, the seed is in its most critical condition and the soil must be kept uniformly moist but not wet. It is often desirable to spread burlap or other light cover on the beds to aid in holding the moisture. This cover must be removed as soon as sprouting begins.

Germination from spring sowing may be completed in from 30 to 50 days, depending upon the species, the temperature, and the moisture. If necessary to thin the seedlings, this work should be done while the plants are small.

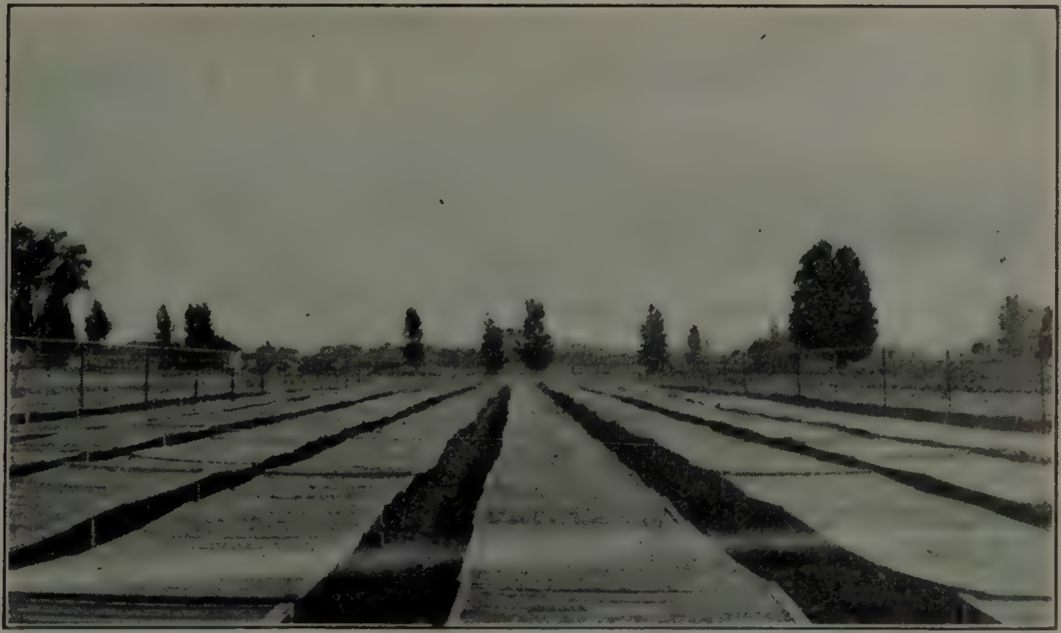

FIG. 3.—Evergreen seed beds protected by lath or other wood strips

SEED-BED CULTURE

The first few weeks after the seedlings come up is the most critical time in the life of the plants, when "damping off" or decay of the stems at the surface of the ground often causes heavy loss. Dry cool air circulating under the lath screens, and the soil suitably supplied with moisture but with the surface of the bed dry, constitute conditions for favorable growth and for keeping the plants healthy. Besides damping off, the young seedlings may suffer from the depredations of cutworms, mice, rabbits, and birds.[2]

The young seedlings are sensitive to drought. The close stand of young plants with their roots near the surface soon exhaust the available moisture, therefore close attention is needed to provide proper moisture conditions.

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[2] The United States Department of Agriculture supplies free information on the control of these pests.

The young seedlings can usually be wintered better by giving them protection in the beds than by lifting and storing them. In late fall the beds should be mulched lightly with pine needles, leaves, or similar material that is free from weed seeds, to guard against lifting or heaving of the roots by alternate freezing and thawing. Likewise, protection from rabbits and mice must be given during the winter.

TRANSPLANTING

When the seedlings have attained a height of 3 to 6 inches they should be transplanted into beds similar to the seed beds. Some kinds of seedlings may attain this size the first season, but the slower growing species, such as spruce and pine, may require two or more years in the seed bed. Early spring is usually the best time for transplanting.

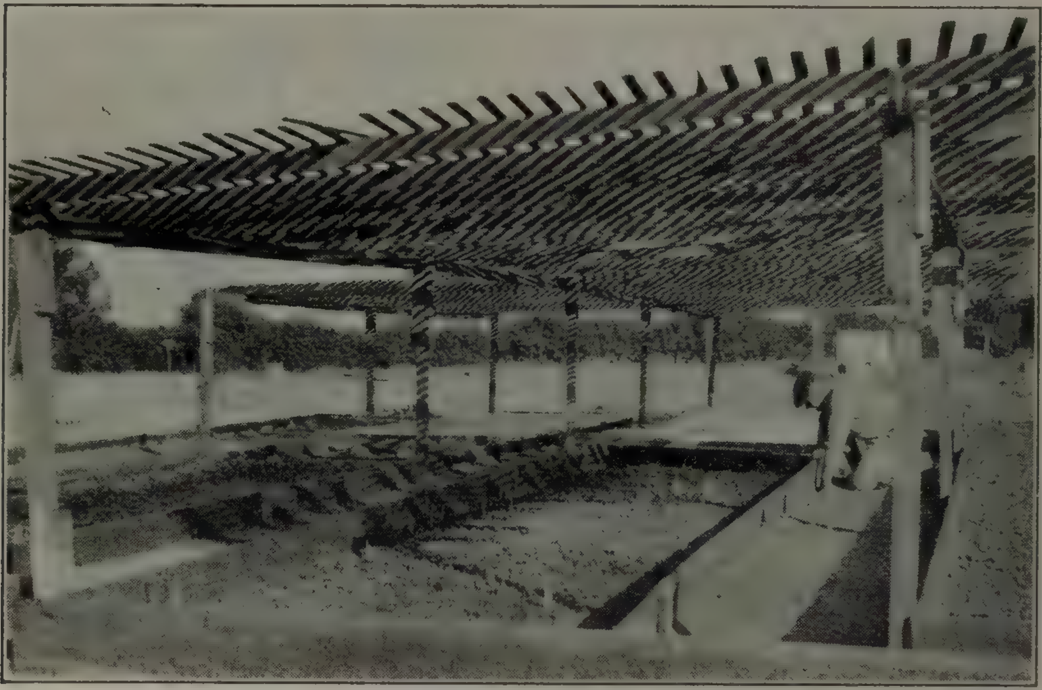

FIG. 4.—Overhead shading for seed beds. Ordinarily the sides are shaded as well as the top

The importance of keeping the roots of evergreens from exposure to dry air while out of the ground can not be overemphasized. A good way to protect the roots is to provide boxes lined with wet burlap in which to place the seedlings. When dug, they are placed in the boxes in layers, and each successive layer is covered with a piece of wet burlap. Dipping the roots in thin mud at the time of digging is a good precaution against drying. Without delay the boxes of seedlings are taken to a cellar or a damp room for sorting into different sizes. All very small and damaged plants should be thrown away. This sorting aids in obtaining uniform development in the transplant bed, because those of nearly the same size can be planted together.

Suitable planting distances in the transplanting beds are from 1 to 2 inches apart in rows 6 to 8 inches apart. Immediately following the transplanting and for two or three weeks thereafter the beds should be watered liberally. By the end of this time root action will have commenced, when the watering should be decreased; but during the growing season the soil should be kept moist to within perhaps an inch of the surface. Frequent shallow cultivation should be given to conserve soil moisture, and all weeds should be kept out. The transplant beds need winter protection similar to that for seed beds. Fast-growing species need only one year in the transplant bed, whereas slower growing ones may remain two years before transplanting again.

DEVELOPMENT IN THE NURSERY

In transplanting to the open nursery rows the same care must be given to the roots as described for the seedlings. As the plants must have space to develop shapely tops, about 2 feet apart in rows 4 feet apart is usually advisable. After one or two seasons' growth in the open, the young trees may be sufficiently developed to be usable for permanent planting. If it is desirable to continue the plants in the nursery to develop a larger size, they should be transplanted every two years.

Seedlings of the same species often vary in the rate of growth, form, and color. As soon as those of undesirable habit can be recognized, they should be disposed of for windbreak or massed planting, rather than to continue to give them the valuable space and the costly care required to develop specimen trees.

DECIDUOUS SEEDLINGS

ORNAMENTALS

Many of the deciduous tree and shrub seeds intended to produce plants for landscape planting can be handled best in beds similar to those described for conifers. However, once germination has taken place nearly all deciduous species are less sensitive to conditions than most conifers. As they usually make faster growth in the seed bed than conifers, it is generally desirable to plant the seed in rows rather than broadcast. One season in the seed bed is sufficient for most species. The second spring they may be transplanted to the open ground, or, in the case of those which grow more slowly, to frames or beds. Some seeds, such as those of the catalpa, ash, locust, and others that are hardy and make vigorous growth from the start, may under favorable conditions be planted in the open ground without the protection of frames or shading. Fruit-tree seeds, which are here considered separately because of their importance, are usually so planted.

FRUIT-TREE SEEDLINGS

Aside from the raising of new varieties, the principal interest in fruit-tree seedlings is for their use as roots in the propagation of varieties by grafting and budding. Seedlings of apple, pear, cherry, and plum for this purpose are mostly grown as special crops in localities where soil and climate are especially favorable to their development. (Fig. 5.) Nurserymen who propagate fruit trees generally find it better, except for the peach and apricot, to buy the seedlings graded and ready for use from specialists who have the conditions and equipment, together with the experience, to grow them in quantity. Certain areas in eastern Kansas, the Yakima Valley in Washington, and the San Joaquin and Sacramento Valleys in California produce most of the fruit stocks grown in this country, though good seedlings are being grown in certain other sections. Considerable interest has recently been awakened in seedling culture.

SOIL FOR FRUIT-TREE SEEDLINGS

Seedlings should attain sufficient size for use in one season's growth. To attain this size, apple and pear seedlings require rich, well-drained soil, preferably sandy loam, with an open subsoil.

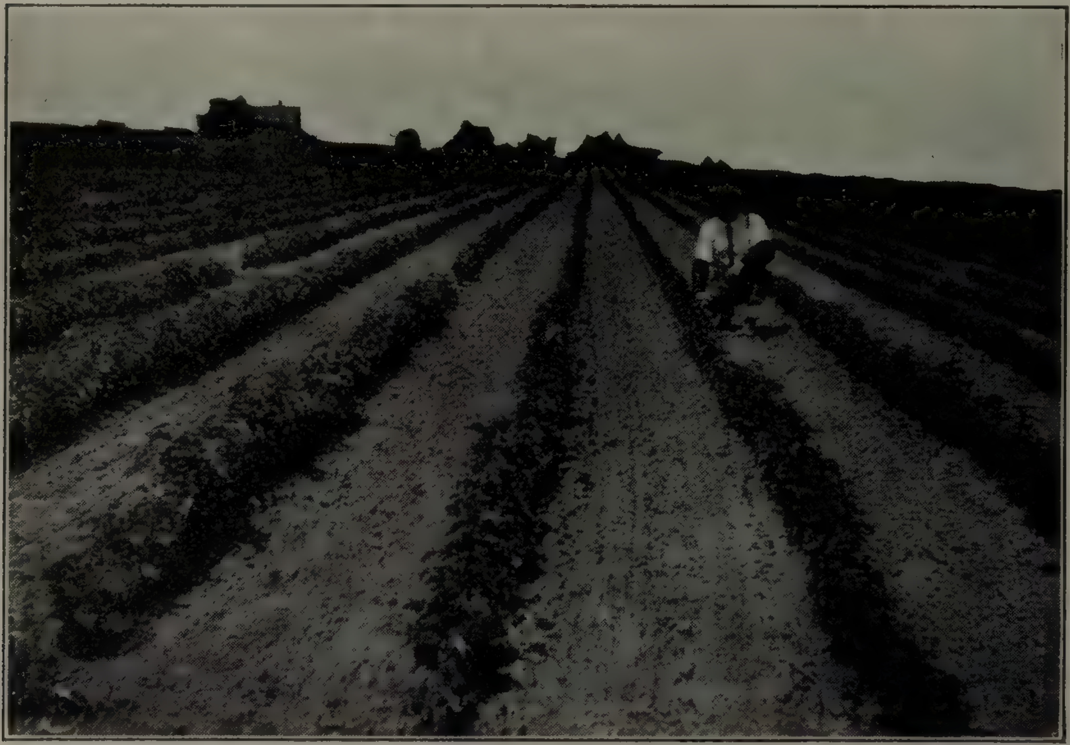

FIG. 5.—A field of fruit-tree seedlings

Cherry and plum seedlings do best on soil that is only moderately fertile; on especially rich soil they are likely to grow too large and fail to mature properly except in irrigated sections where the growth can be controlled in the fall by withholding the water. It is advisable to prepare the soil in advance by plowing under a green crop, such as cowpeas or clover, and by ridding the land of weeds as far as possible. In the fall before planting it should be plowed deeply and the surface pulverized and leveled.

PLANTING

The seed may be planted either in fall or in early spring. Fall planting is desirable if the ground can be put in good condition and the seed obtained in time. If planted in the spring the seed should be put in as early as the ground can be prepared properly. If a seed drill is to be used for planting, the moist seed is dried just enough so that it will run through the drill freely. Apple, pear, and cherry seeds are covered usually about 1 inch deep in rows spaced wide enough for horse cultivation, or they can be grown in beds for hand culture. For nearly all fruit-tree seedlings a stand of 10 to 15 seedlings per foot is desirable. To obtain this stand, seed must be used rather freely unless it is known to be of very good germinating quality.

Apple seed is often obtained from pomace from cider mills. Power cider mills which have sharp knives for cutting the apples often injure a considerable proportion of the seed. When planting, allowance must be made for such defective seeds. Small hand cider mills usually injure but few of the seeds.

Often cherry and plum seedlings can be grown to advantage in double rows, spacing the rows about 6 inches apart with space for horse cultivation between the double rows. On especially good soil seed may be sown in a shallow furrow, scattered over a strip 4 to 6 inches wide, thus permitting a larger number of seedlings per foot of row.

As soon as planted it is advisable to draw a ridge of soil 3 or 4 inches high over the row, to aid in keeping the seed moist at all times and to check washing out, but this ridge must be removed as soon as germination is well advanced. The seed should come up within two or three weeks after warm weather begins. If thinning is necessary it should be done while the plants are small; overcrowding is sure to produce many small, worthless plants.

CULTURE

Efforts should be made to encourage all the growth possible during the early part of the season. Frequent cultivation with a wheel hoe and hand weeding while the seedlings are small are necessary. By early summer the seedlings are generally large enough for horse cultivation. The soil should be stirred frequently during the summer. Cultivation should be discontinued in early fall to avoid further stimulation of the growth, with a view to securing well-matured firm wood. If grown under irrigation, it is advisable to withhold water during the latter part of the autumn to permit proper ripening of the wood.

DIGGING

Digging should be delayed until late in the fall; the quality of the seedlings is impaired when they are dug prematurely. If necessary to dig them before the leaves have fallen, they are placed in small piles, covered with soil immediately, and allowed to remain a few days to remove the leaves. They are then ready to be sorted into different sizes. For convenience in handling, the tops are cut back and the soil shaken or washed off.

GRADING

Custom has brought about the recognition of certain standards in seedling sizes. As usually defined, the grades are as follows: No. 1 grade in all types of seedlings, caliper from three-sixteenths to about five-sixteenths of an inch. The caliper measure is taken just at the collar. Sometimes an extra large grade above the No. 1 is made of all the seedlings from one-fourth to seven-sixteenths of an inch caliper. The No. 2 grade is from one-eighth to three-sixteenths of an inch, except in the case of the apple; No. 2 apple seedlings are graded two and one-half-sixteenths to three-sixteenths. Apple seedlings are separated into two types—straight roots, which are preferred for piece-root grafting because two or more grafts can be obtained from a single root, and branched roots, which are preferred for budding and whole-root grafting. In grading the straight type, the roots should maintain practically the full size of their grade to a length of 8 or 9 inches in the case of the No. 1 grade, and to 6 to 8 inches in the case of the No. 2 grade. (Fig. 6.) Those that taper out to a smaller size before reaching this length are called "stubs" and are used either for whole-root grafts or for planting out to bud later in the season. Smaller seedlings than No. 2 grade are little used except where conditions favor unusually large growth, as in some of the Southern States and certain irrigated sections of the Pacific States.

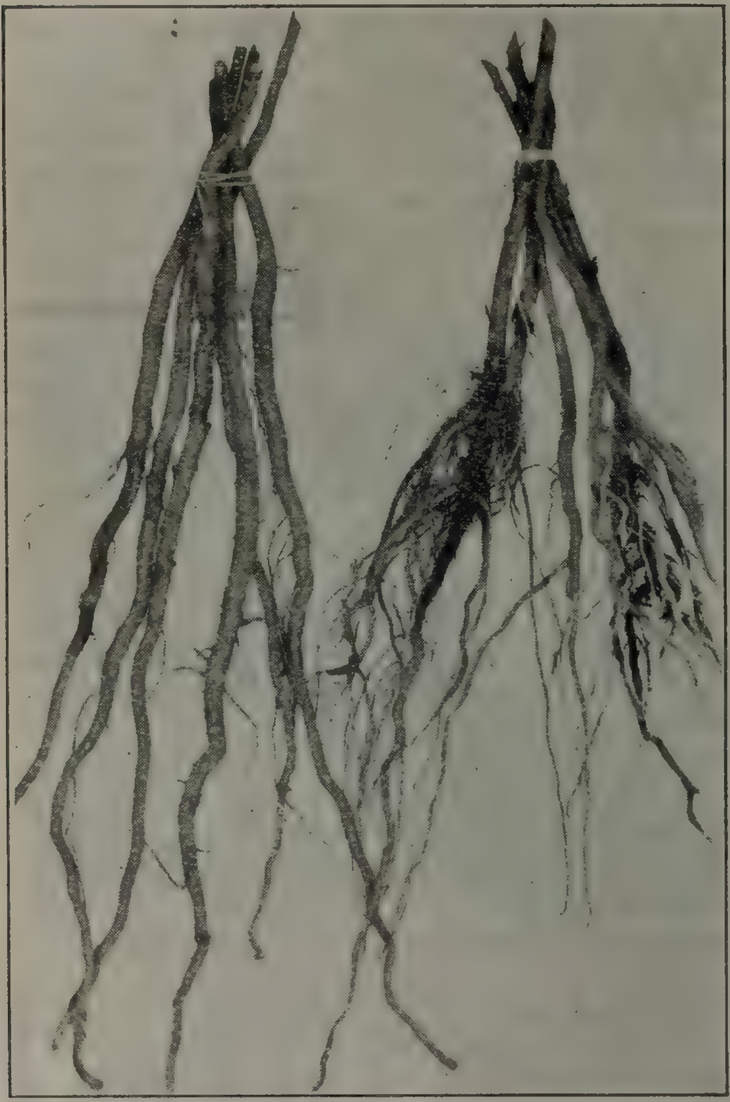

FIG. 6.—Straight-root and branched-root apple seedlings

PROPAGATION BY CUTTINGS

Cuttings are extensively employed for the propagation of woody plants as an assurance that the new plants will be similar in all respects or true to variety. Many kinds of ornamental trees and shrubs and a few kinds of fruit trees and plants will grow from cuttings. They vary greatly, however—even varieties originating from the same species—in their readiness to form roots.

CLASSES OF CUTTINGS

Cuttings are made both from growing wood and from mature wood. For the purpose of treatment stem cuttings taken from wood in active growth at various stages of immaturity may be classed as immature or half-ripe cuttings. These are usually rooted under glass in summer. Those taken from fully matured wood during the dormant season may be classed as hardwood or dormant cuttings. Deciduous hardwood cuttings are ordinarily planted in the open ground in the spring, whereas evergreen cuttings are usually rooted in greenhouses during the fall and winter months. Some kinds of trees and shrubs may also be propagated by cuttings made from roots.

The practical choice between the two classes of stem cuttings depends on circumstances. Some plants root easily from immature cuttings under glass, but with difficulty from mature wood in the open ground; others root easily from either class of cuttings, although even from these a more rapid increase may be obtained from a given number of plants by half-ripe cuttings if a greenhouse or hotbeds are available. Although such cuttings require close attention during the process of rooting, a large number may be accommodated in a small space. On the other hand, if plenty of wood is to be had, or if glass equipment is lacking, the best results for a number of deciduous kinds may be obtained by the use of hardwood cuttings planted in the open ground.

PLANTS OFTEN INCREASED BY IMMATURE CUTTINGS

Among the different varieties of deciduous trees and shrubs that are frequently started from cuttings under glass in summer are abelia, azalea, crape myrtle, deutzia, forsythia, honeysuckle, hydrangea, lilac, mock orange, privet, rose, spirea, snowberry, and weigelia. Under good conditions these and a number of others may be expected to root within a month or two. Certain evergreens also are so propagated, including varieties of arbor vitae, boxwood, holly, and retinospora. They may require a longer period to form roots, often two or three months.

FACILITIES

A high degree of humidity in the air around the cuttings is necessary to keep them fresh while roots are in process of formation. Rooting is hastened by maintaining the sand or other rooting medium 5° to 10° warmer than the surrounding air. This bottom heat is not essential, however, for most kinds of cuttings during warm weather. To provide such conditions, the most convenient type of structure is the modern greenhouse designed for the purpose. In such a house as is shown in Figure 7 the temperature, light, humidity, and sanitation can be given proper attention with a minimum of labor. However, good results can be obtained with less expensive facilities. Ordinary hotbed frames covered by glass sash are used in many places, and large quantities of cuttings of trees and shrubs are rooted in them each summer. In localities favored by warm, nearly uniform temperature, cuttings may be rooted in frames protected by muslin instead of glass and without special provision for bottom heat.

ROOTING MEDIUM

Clean sand of a texture fine enough to retain moisture around the cuttings but coarse enough to allow water to drain through it freely is the rooting medium most generally used. Sand such as builders use for plastering often is suitable. It should be free from organic matter and all foreign materials such as lumps of clay. If necessary it should be passed through a screen to remove coarse gravel and then washed to free it from sediment.

FRAMES FOR SUMMER CUTTINGS

Where hotbeds are utilized the frames are usually made for ordinary 3 by 6 foot sash. For convenience in shading, it is advisable to have the frames run east and west with the glass sloping to the north. They are commonly made about 2 feet deep, so constructed that half or more of their depth is below the ground level. (Fig. 8.)

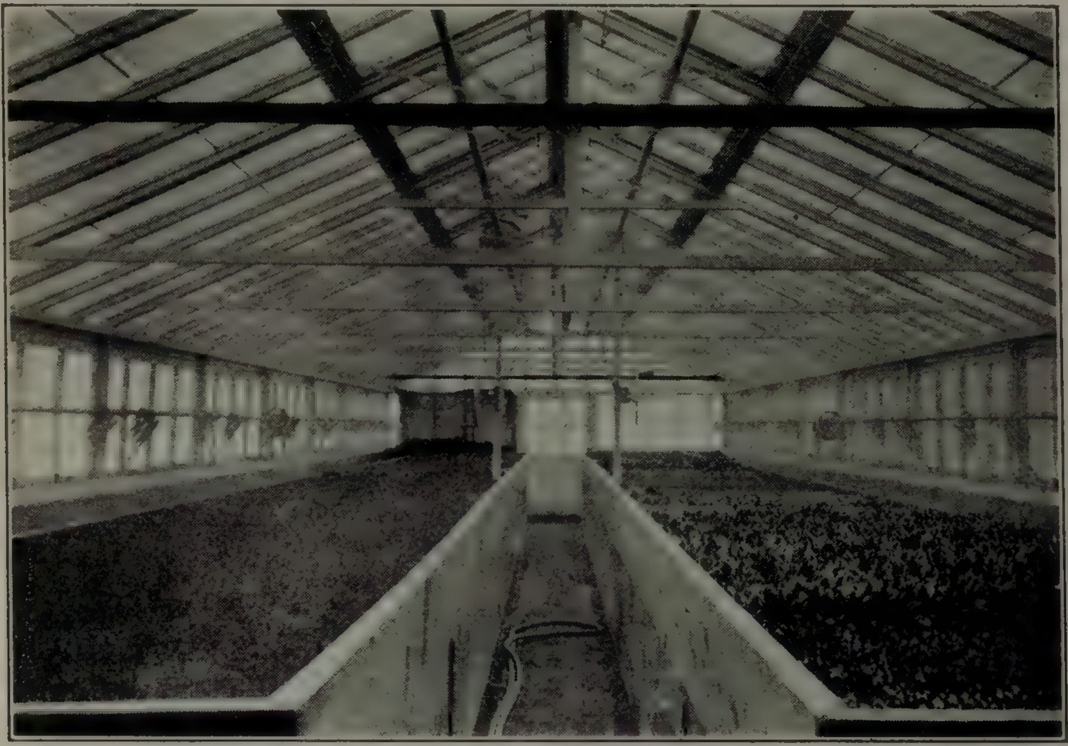

FIG. 7.—Greenhouse designed for propagation of evergreens. Concrete benches 4 ft. 6 in. wide piped for bottom heat of 55° to 65° F. night temperature in the sand, with air temperature 50° to 55°. Benches can be converted into grafting cases by covering them with glass sash. Walk in middle, 2 ft. 6 in. wide. Walks at each side 2 feet wide. Crossbars overhead are provided to support canopy when needed. For the best light, such a house should run north and south

In June or July, when the new growth of the varieties to be propagated has reached the proper stage, the frames are prepared by putting in sufficient stable manure to make a depth of about 1 foot. This material not only provides a mild heat but also insures good drainage. After leveling the manure carefully, a layer of 4 to 6 inches of clean sharp sand is placed on it. When the first strong heat from the manure has been spent, usually within two or three days, the frame is ready for the cuttings.

Instead of placing the sand directly on the manure, it is frequently desirable to put it in shallow boxes or "flats" about 16 by 20 inches. or of other convenient dimensions, and about 4 inches deep. When planted with the cuttings these flats are placed in the frames, care being taken that they are set level and fitted close against one another. One advantage to be derived from the use of flats is that if the cuttings do not root during the period in summer when conditions are favorable in the frame they can be transferred to a greenhouse bench in the fall. This necessity for a longer period for rooting is more likely to occur with evergreens or cuttings put in late in the season than with deciduous cuttings made earlier in summer.

SHADING

An important feature of summer propagation is the proper shading of the cuttings. Direct sunlight must be kept off, but as much light should reach the cuttings through the sash as can be given without overheating them. Shading can be provided in several ways, one of which is to stretch a canopy of heavy muslin on supports 3 or 4 feet above the frame and along the south side, and so arranged that it can be readily put in place in the morning as soon as the rays of the sun begin to reach the cuttings and taken off in the late afternoon and during dark, cloudy days. (Fig. 8.) This covering serves to keep the cuttings in a moisture-laden atmosphere with the temperature preferably between 70° and 90° F. A canopy over the glass is preferable to painting the glass with whitewash, as it enables a better control of the light.

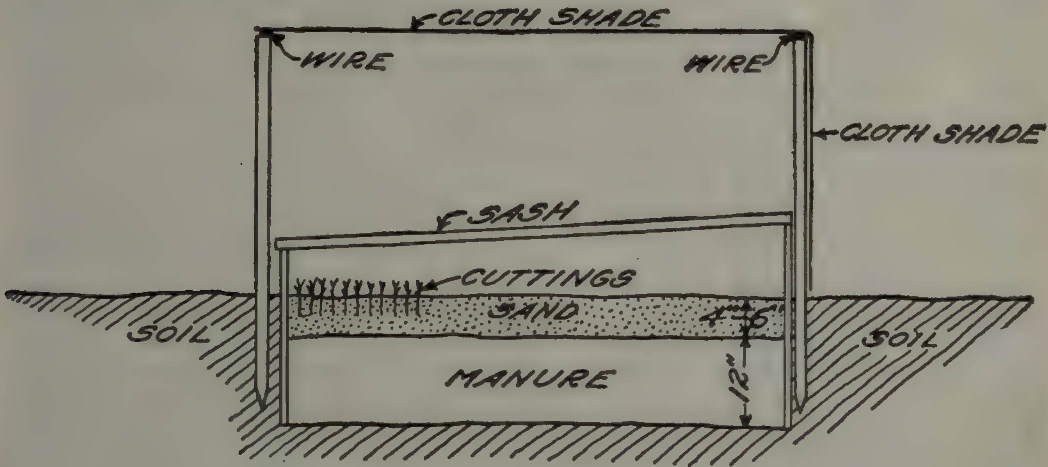

FIG. 8.—Section of frame for summer cuttings

WOOD FOR SUMMER CUTTINGS

The plants from which cuttings are to be taken must be healthy and vigorous if the best results are to be obtained. Cuttings from plants affected by leaf diseases or otherwise in poor condition nearly always prove disappointing. The best stage of growth to use varies with different kinds of plants. It can best be learned by experience and close observation of the cuttings in the sand; some root easily at almost any stage of growth, whereas others are more particular and succeed well only when the growth has reached a certain stage. Cuttings of a number of the spring-flowering shrubs thrive if taken from the vigorous growth that follows the period of blossoming. Generally, the wood taken just as it is beginning to harden will root more quickly than the harder wood.

SUMMER CUTTINGS

Summer cuttings are made usually 3 to 4 inches long with the lower end cut through a leaf joint. The leaves are removed except one or two at the top, which may be left entire, or, if large, part of each may be cut off. (Fig. 9.) When the largest number of cuttings from the wood available is desired, each cutting is made to include but a single joint with the leaf at the top. A sharp thin-bladed knife is necessary to insure clean, smooth cuts without loosening or disturbing the bark. As fast as the cuttings are made they are dropped into clean water or placed under moist paper to keep them from wilting. They should be planted with little delay.

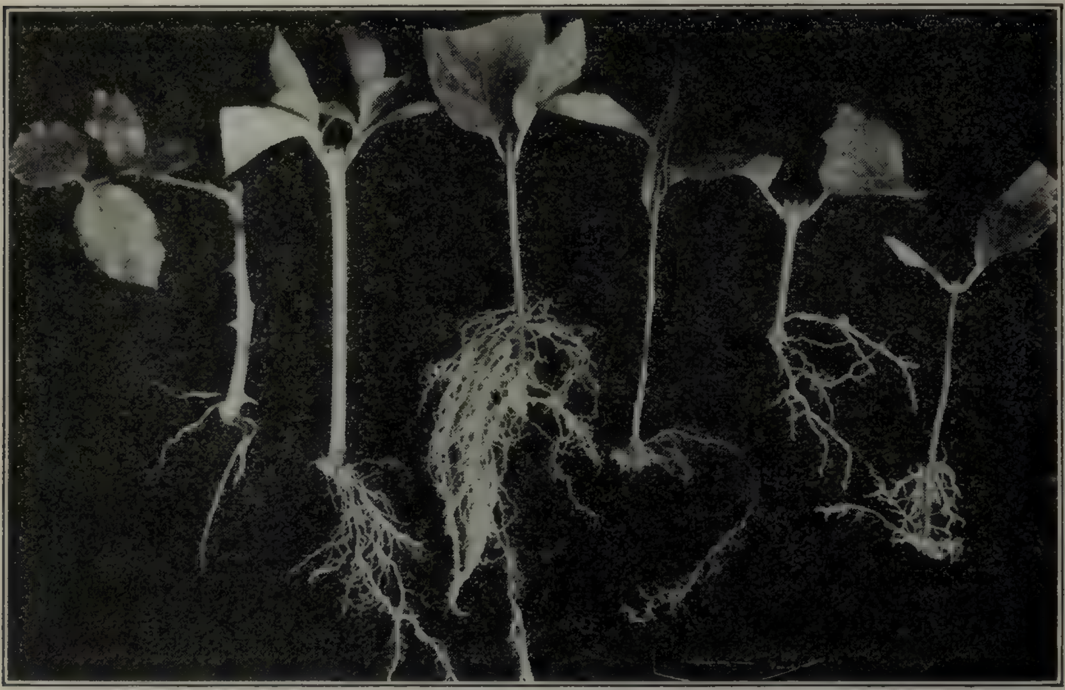

FIG. 9.—Rooted cuttings of immature wood of rose, weigela, mock orange, spirea, lilac, hydrangea

INSERTING THE CUTTINGS

The sand is moistened, leveled, and tamped as firmly as possible with a brick or block of wood, and then a groove is cut (with a case knife or a thin piece of wood), into which the cuttings are planted upright about 1 inch apart at such a depth that most of the stem is in the sand. When a row is placed the sand is made as tight as possible around the cuttings, by firming it first with the fingers and then laying a straight-edged strip close to the row and striking it lightly with a hammer or mallet. If it is not well tamped, too much air may be admitted around the base of the cuttings, causing them to dry out. The rows may be spaced from 2 to 4 inches apart, or as far as necessary to prevent much overlapping of the leaves. As soon as planted they must be watered thoroughly. It is not necessary to fill the entire bench or frame at once; the work of making and inserting the cuttings may extend over several days.

CARE OF CUTTINGS IN THE SAND

At first the beds or benches are kept closely covered. After the first week it may be desirable to admit a little fresh air for a short time each day, to reduce the danger from mold or other fungi. It is necessary to syringe the tops of the cuttings and the glass and sides of the inclosure lightly two or three times daily for the first few days, to keep the air saturated and to avoid wilting. Later, when the cuttings have begun to draw up moisture through their stems, less spraying is needed except during very hot days. Cuttings usually will root sooner if the leaves left on them can be kept fresh until roots have started; hence the care of the beds should be such as to maintain these leaves in a growing condition.

TREATMENT AFTER ROOTING

When well rooted the cuttings are transplanted into either small pots or flats of soil. They are very easily injured when first taken from the sand and therefore must be carefully handled and protected from wilting. At first they should be placed where moisture and temperature can be kept similar to those of the benches or beds in which they were rooted, but as they gradually become established more air and light are admitted to harden the young plants. After two or three weeks, when active growth has begun, they may be transferred to lightly shaded coldframes or to a well-ventilated greenhouse bench.

EVERGREEN CUTTINGS FROM MATURE WOOD

A number of choice varieties of evergreens which do not come true from seed may be increased without difficulty in various types of greenhouses during winter as well as in frames during summer. Among these are varieties of arbor vitae, boxwood, juniper, retinospora, yew, and a number of others. Most varieties of evergreens are slower to root than deciduous plants. Arbor vitae and retinospora cuttings may root within two months, while some forms of juniper may require six or eight months, or may even remain until the second year and then strike roots.

The wood for the cuttings is usually in good condition in fall after a few light frosts have checked the growth and it has ripened. Cuttings may be made at any time up to midwinter with good results. The wood, however, should not be cut or handled while in a frozen condition. The vigorous branches on the sides and near the tops of the trees furnish the best wood.

The cuttings are usually made from 3 to 8 inches long. Often the side shoots may be stripped from the branches to include a small portion or "heel" of older wood. This heel is desirable though not essential. The foliage is removed from the lower portion of the stem, leaving a part of that at the top. (Fig. 10.)

The cuttings are inserted in the sand so that about half their length is covered. They are spaced one-half to 1½ inches apart in rows, according to the size of the cuttings. Sufficient space should be left between the rows so that the sunlight may reach the sand, as an aid in keeping fungi in check. Care must be taken to settle the sand very firmly around the cuttings, as previously described for summer cuttings. As soon as planted the bench must be watered thoroughly.

At first some shade over the cuttings is necessary. This may be provided by a single thickness of newspaper laid over them for a few days. In cold weather, however, little shade, except perhaps in midday, will be needed, and direct sunlight may be beneficial; but with the longer, warmer days of spring, some shade must be provided. The ventilators should be kept closed except for a short time in the middle of the day, to keep the air moist at all times. If other stock requiring ventilation is being grown in the same house, the bench of evergreen cuttings should be screened by means of muslin or burlap curtains. Watering is necessary only when the surface of the sand begins to dry.

A temperature of 50° to 60° F. at night is often regarded as most desirable, although evergreen cuttings will stand considerable variation without injury. From 40° to 50° at night is sufficiently warm to maintain most coniferous cuttings in good condition during winter. Rooting may be expected during the spring months. In March or April the bottom heat should be increased to hasten root activity.

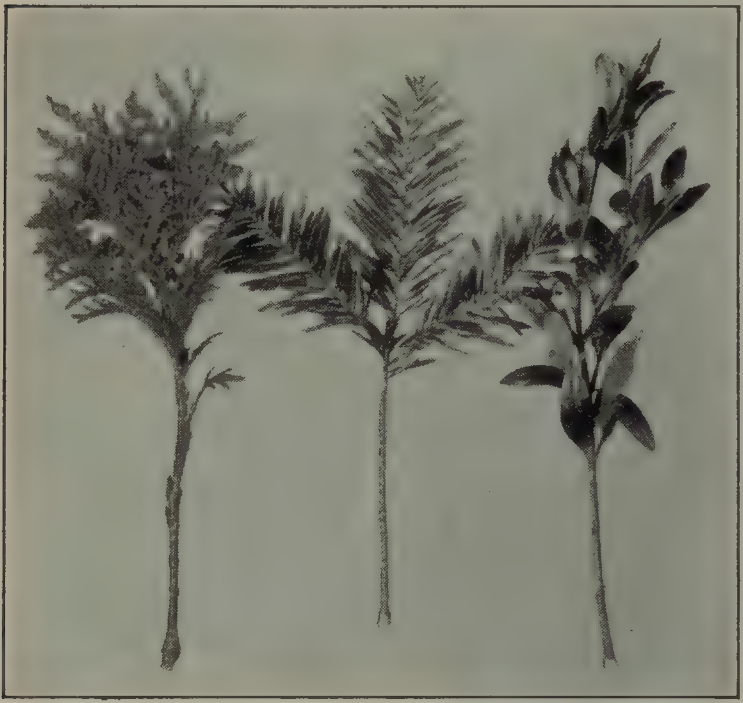

FIG. 10.—Cuttings of arbor vitae, yew, and boxwood

When rooted, the cuttings are usually potted or planted in flats and kept in the greenhouse until they are in active growth, then transferred to coldframes in late spring. Some growers, however, prefer to let them remain in the sand until more roots have formed and then transplant them into outdoor frames in May or June, giving close attention to watering and protecting them from sun and wind until they have become established in the soil.

DECIDUOUS HARDWOOD CUTTINGS

Hardwood or dormant cuttings planted in the open ground afford one of the most important means of propagating a considerable number of deciduous trees and shrubs for ornamental and windbreak planting. Among the trees so propagated are the willows and poplars; among the shrubs are included such species as deutzia, honeysuckle, mock orange, privet, spirea, tamarix, and weigela, together with some varieties of barberry, dogwood, and rose; among the fruits are the currant, grape, and fig. The different species and varieties vary in their readiness to form roots on hardwood cuttings, as is the case when immature cuttings are used. Moreover, some kinds that are easy to grow in one locality may prove difficult in another; for example, some oriental pears and their hybrids, often grown from cuttings in Florida and other parts of the South, usually fail in sections farther north.

THE CUTTINGS

The form of hardwood cuttings usually employed consists of a straight portion of a twig of one season's growth, containing two or more leaf buds. At the lower end it is usually cut through or just below a leaf bud. Cuttings taken to include a small portion of the older wood at the base of the twig, called "heel cuttings," are preferred in some cases, but have the disadvantage that only one such cutting can be made from each twig.

Wood of one season's growth of medium size and well matured should be chosen. The best time to cut the wood from the plant is in the late fall or early winter. It can be kept in good condition until it is made into cuttings by packing it in slightly moistened sawdust or moss and storing in a cool cellar, or it can be buried in the open ground. If it is necessary to cut the wood from the plants in the winter when frozen, it must be handled carefully and placed in a cool room or in cold water to thaw.

Cutting may be made any time during the winter, but the best results are obtained by making them in January or February, or at such time that they may be kept nearly inactive for several weeks. When a long, cool period without freezing the soil may be expected to follow, they may be planted when they are made, with good results.

Most hardwood cuttings are made 5 to 10 inches in length. Usually 6 inches is long enough, but whatever length is chosen it is desirable to make them uniform in order to facilitate handling. Wood with long joints, such as that of the grape, should be cut to include at least two buds. As a rule, roots form most readily at a leaf joint, therefore it is customary to cut the lower end through or just below a bud. The upper end is cut a short distance above the top bud. When made, the cuttings are tied in bundles of 50 or 100 each, taking care that they are all laid one way to facilitate planting them right end up.

STORAGE OF HARDWOOD CUTTINGS

The bundles of cuttings are packed in slightly moistened material, such as sphagnum moss or sand, and stored in a cool place where they will remain fresh. Frequently they can be kept in good condition by burying them in a well-drained place in the open ground and providing protection from excess water and from freezing. When buried, it is customary to place the cuttings with the butt ends up.

The first change seen in the condition of the cuttings is the formation of a mass of tissue on the lower end, known as callus. Although roots do not ordinarily arise from the callus itself but from the tissues underneath or along the stem above it, this formation is a common preliminary to rooting. Some kinds of plants, however, may root without any apparent callus tissue.

SOIL AND ITS PREPARATION

Well-drained fertile sandy loam is to be preferred, though cuttings can be grown in any good soil suitable for ordinary garden crops. Thorough preparation in the fall is usually necessary, so that the cuttings can be planted without delay in the spring. The soil should be plowed deeply and the surface harrowed and smoothed, as for small seed crops.

PLANTING

Planting should be done before growth starts from the buds. Early spring is the usual time, although the cuttings can be planted in the fall in sections where the winter is mild. Farther north autumn planting may be practiced if sufficient mulch is put over the cuttings to protect them from lifting out of place caused by freezing and thawing.

The cuttings are usually planted in rows far enough apart for horse cultivation, but they can be grown in beds to be cultivated by hand tools. When spaced for horse culture, a small plow can be used to open the furrow. The cuttings are set in a vertical or slightly inclined position with the top bud near the ground level. (Fig. 11.) Very long cuttings must be planted in more reclined positions to avoid a too deep planting of the lower ends. Ordinarily they are spaced from 2 to 6 inches apart in the rows. When they are grown in beds for wheel-hoe cultivation a spade is used to open the trench for planting. It is important that the soil be well firmed about the lower ends of the cuttings and that nearly their entire length be covered with soil.

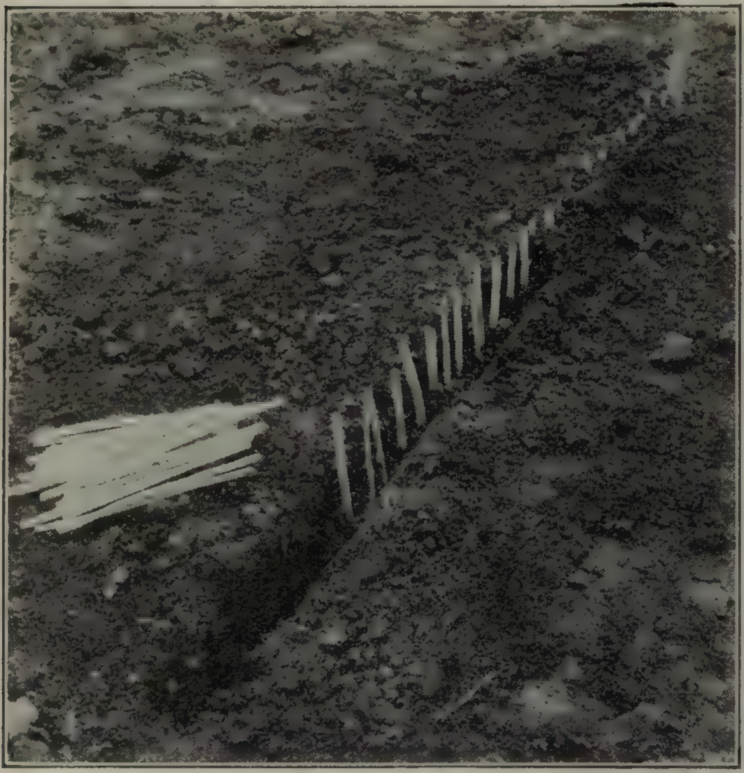

FIG. 11.—Hardwood cuttings in place in a trench

CULTURE

If the cuttings are to be profitable it is just as essential to obtain a robust growth as it is to root them, therefore the culture should be such as to encourage maximum growth, especially during the early part of the season. Frequent cultivation is necessary, and all weeds should be kept down.

ROOT CUTTINGS

Some kinds of woody plants may be propagated from cuttings made from roots. The advantageous use of root cuttings is confined mainly to plants difficult to root from stem cuttings. The apple, cherry, hawthorn, flowering quince, plum, and pear may be mentioned among trees that are frequently more easily grown from root cuttings than from stem cuttings.

To provide root cuttings the trees are dug in late fall, or, in mild climates, during the winter, care being taken to obtain all the roots uninjured. The trees are heeled in or stored to keep the roots in good condition. In the late winter or early spring the roots are trimmed off, leaving only enough on the mother trees to enable them to continue growth. Then these trees can be replanted after pruning the tops, preferably in fertile sandy loam, to produce another crop of roots.

Roots from one-fourth to one-half inch in diameter are the most desirable size for cuttings, although smaller ones will grow if given favorable conditions. They may be planted in the open ground in the spring as early as the soil can be put in good condition, or started in a greenhouse at a temperature of 50° to 60° F., or in a frame to be transplanted to the open after growth has started.

Best results are obtained by making root cuttings two or three weeks in advance of planting time. This permits them to callus and begin the formation of leaf buds while stored at a temperature of 40° to 50° F. under conditions similar to those used for hardwood cuttings. The most desirable length to make the cuttings depends on the conditions under which they are to be started. For planting directly in the open ground, 3 inches is a desirable length; for starting indoors 1 to 1½ inches is sufficient length, thus procuring a much larger number of cuttings from the same amount of material. For convenience in handling, the cuttings are made into bundles of a size to hold in the hand. Rubber bands are easier to use than twine for making the bundles.

Leaf buds usually arise near the top end of a root cutting; that is, the end that grew nearest the parent tree, whereas new roots form at the lower or distal end. Hence the best condition for growth and the best formed plants are obtained by planting the cutting in a vertical position. The formation of leaf buds and roots on a root cutting is illustrated in Figure 12.

When planted in the open ground, the cuttings should be placed with the top end near the ground level, taking care to firm the soil well around them. A ridge of soil 2 or 3 inches high is then drawn over the row to maintain moisture around the cuttings and to prevent a crust from forming in close contact with the tops. This ridge should be raked off when the shoots have grown about 1 inch. Under ordinary conditions this stage of growth is reached about a month after planting.

PROPAGATION BY LAYERS

Layering consists in bringing branches or shoots into contact with the soil to develop roots while still attached to the mother plant. It is one of the simplest and surest methods for propagating many kinds of woody plants. When only a few new plants are required, layering may be advantageously employed even for many kinds which are ordinarily increased by cuttings, because layers require less attention than cuttings. On the other hand, layering is not commonly practiced on a large scale, except in the case of certain kinds not readily increased by other means, because a comparatively large number of mother plants must be provided, and in other respects the operation is somewhat cumbersome.

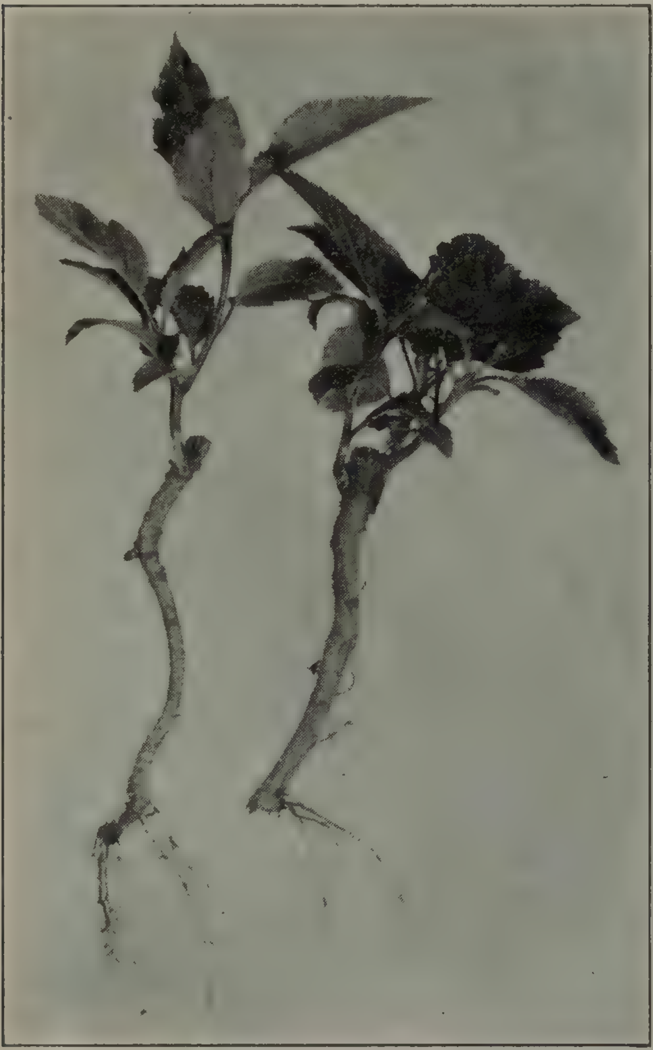

FIG. 12.—Root cuttings of apple species about one month after planting

Layering may be done in several different ways. The most useful for trees and shrubs includes simple layers whereby roots are developed on a buried portion of a branch, and stool layers and trench layers, whereby roots are developed on new shoots arising from the buried portion.

SIMPLE LAYERS

Simple layers are made by bending branches to the ground and covering a part of their length 3 to 6 inches deep, so that the buried portion will remain in moist soil during the process of rooting. Generally this is done in the spring before growth begins. The tip ends of the layered branches are left exposed to form the tops of the new plant. Frequently rooting is stimulated by making a slanting cut into the branch on the lower side at the point where roots are desired. Many trees and shrubs so treated will strike roots the first season, whereas others may require two seasons. When well rooted, the layers are severed from the mother plant during the dormant season and treated as independent plants.

The propagation of rhododendrons exemplifies one of the applications of this method. The varieties desired are planted several feet apart to allow space to bend all of the branches to the ground.

Previous to layering, the plants are allowed to become well established and are headed low to induce vigorous shoots to start near the ground.

During March or early April is the usual time for putting down rhododendron layers. The growth made the preceding season is the best, but older wood will form roots. The branch is prepared by stripping off a few leaves from the portion of the stem to be buried and by removing any flower buds. At the point where the roots are desired on the branch, a cut is made about 1½ inches long, running upward and slanting toward the center of the branch, thus forming a "tongue." The shoot is then gently bent over to avoid breaking and is so buried in the soil that the tongue points nearly straight downward and is several inches below the ground level, with 6 inches or more of the tip of the shoot nearly erect above the ground. The branch is held in this position by wooden pegs or stiff wires, and the soil is pressed firmly around it. All of the vigorous branches of the mother plant that can be brought to the ground may be treated in the same manner. (Fig. 13.)

FIG. 13.—Layered rhododendrons

The soil around the buried portion should be moist all through the season. A heavy mulch of oak leaves for rhododendrons and other plants requiring acid soils helps to retain the necessary moisture and also improves the soil as the leaves decay.

Rhododendron layers make the best plants if they are allowed to remain two years, although some roots may form the first season. The second spring they are severed from the mother plants and carefully transplanted into beds of especially prepared soil. The first year these beds should have lath shade and facilities for watering. The second season they are ready to be transplanted to the open ground.

STOOL LAYERS

Stool or mound layering is well adapted to plants that form shoots freely near the ground level. It is the method often employed for the propagation of the quince and gooseberry, also the Doucin and Paradise types of apple used for dwarfing stocks.

Fertile sandy loam which is easily worked and in a situation that is nearly level to avoid washing should be selected for mound layers. After the beds are established, yearly crops of rooted shoots can be obtained from them without renewing the mother plants; hence especial consideration in the choice of a favorable site is important.

The plants to be propagated are spaced 4 to 5 feet apart each way, a sufficient distance to allow ample room for root development and to permit a mound to be made several inches high around each plant. They are grown a year before layering to become well established, during which time they are given care to encourage as much growth as possible.

Before growth starts the following spring the plants are cut off at the ground level. When the shoots growing from the stubs are 4 or 5 inches high, soil is drawn up leaving only the tips exposed. It is advisable to spread the shoots a little apart when hilling the first time, to give each shoot more space and to induce uniform growth. Root formation is aided if the hilling is begun while the shoots are still small. As growth progresses, from 4 to 6 inches of soil are drawn up around the shoots at intervals during May and June. Figure 14 shows such a stool with the rooted layers ready for removal. The rooted shoots can be cut off in the late fall or early the next spring. The stubs or "stools" are left undisturbed, to produce another crop of shoots the following year.

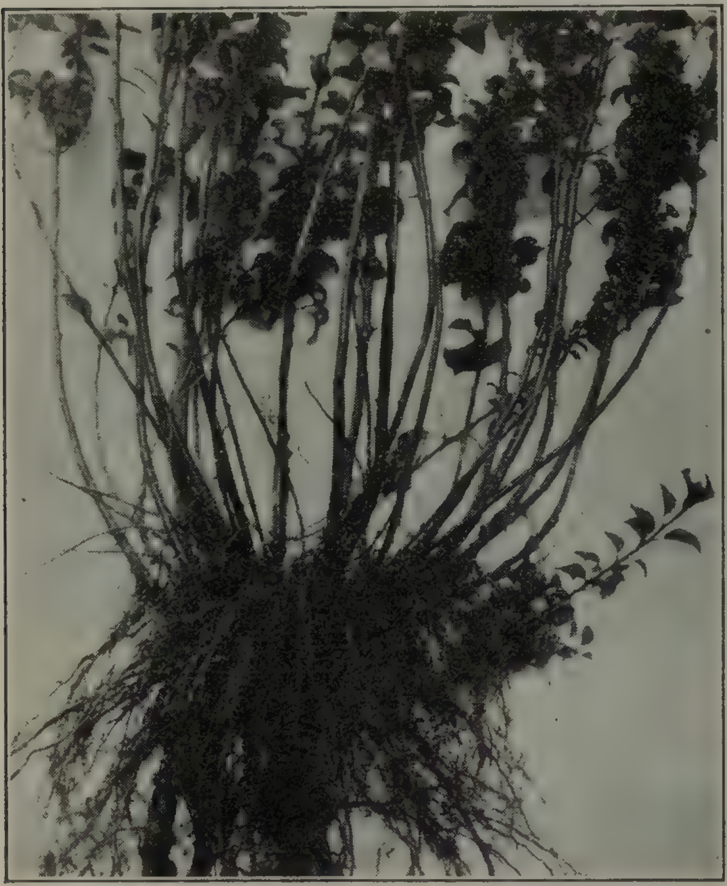

FIG. 14.—Mound or stool layers of Paradise apple

TRENCH LAYERS

Instead of cutting back the mother plants to form stools, the stems may be brought down into a furrow made 4 to 6 inches deep beside the row (trench layering). This is done early in spring before growth starts. Care should be taken to peg down the branches horizontally in the bottom of the furrow at the same distance below the ground level. Two or more stems may parallel and overlap each other, thus providing for a close stand of new shoots in the row. When the new growth is 2 to 4 inches long, soil is brought in to cover the lower part of the new growth, leaving only the tips exposed, and, as growth develops, more soil is brought around the stems. Roots ordinarily form most readily near the base of the shoot, hence this portion should be sufficiently covered by soil that is constantly moist. As rooting may frequently take place most freely in the fall, it is advisable to defer the removal of the rooted layers until very late in the autumn or early the following spring. (Fig. 15.)

PROPAGATION BY GRAFTING AND BUDDING

Grafting and budding are the means employed to propagate most of the fruit-tree varieties and some ornamental plants whose seeds do not reproduce the characteristics of the variety and whose cuttings do not root easily. In addition to multiplying plants of the varieties desired, other objects that may be sought are to secure better trees by the use of hardier or more vigorous or disease-resistant roots; to change the rate of growth of the tree, for example, the use of quince roots to produce dwarf pear trees; or to change orchard trees from one variety to another.

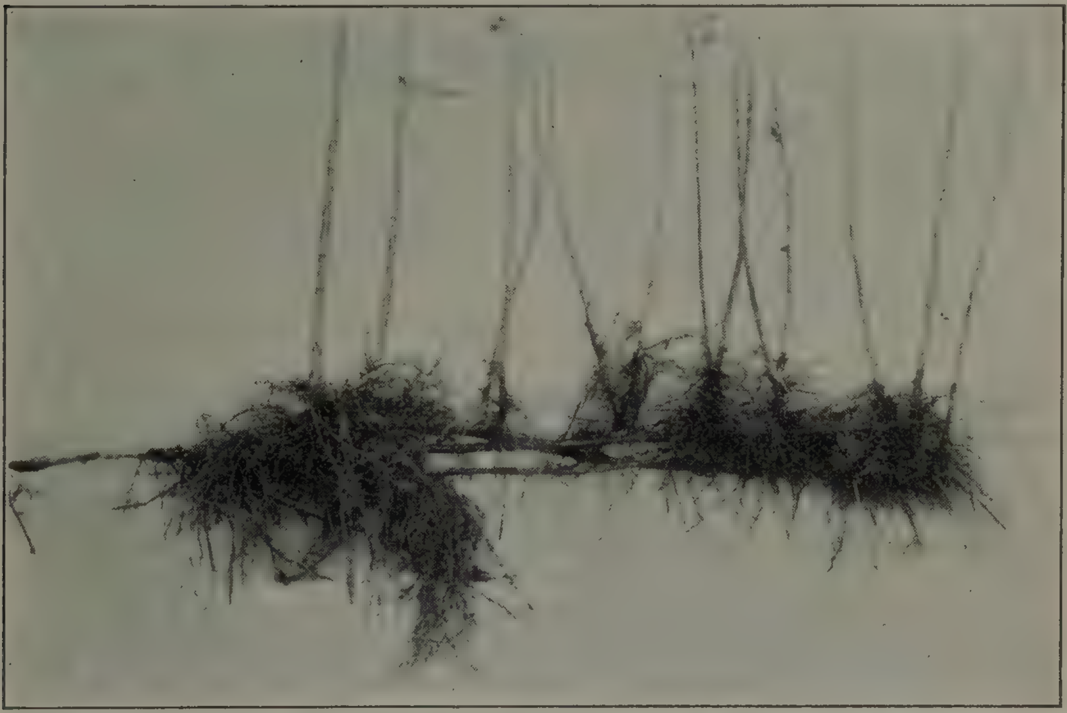

FIG. 15.—Trench-layered Doucin apple roots on new shoots formed in one season

A grafted tree is made by the union of two parts—the scion, which is cut from a twig of the variety desired from which the top is to be developed, and the stock, which is usually of the same species or a closely related one, from which the root system is to be developed. Given these two parts of close botanical relationship, the essential for a successful union is that the cambium layer of the scion be brought into close contact with that of the stock and held there under suitable conditions until the two parts have grown together. The cambium layer is the thin zone of cells between the wood and the bark from which new tissues are developed.

Budding differs from grafting in the use of a single bud instead of a scion and also in the season of the year when the operation is performed. Budding is done in summer while growth is active, whereas grafting is usually done in winter or spring with dormant scions. The resulting trees are essentially the same whether propagated by budding or by grafting.

Local conditions, the kind of plants to be propagated, and the expense and convenience determine the choice between budding and grafting. In general, stone fruits are budded oftener than grafted. Apple and pear are grafted more frequently in the Central States and budded in other sections, although both methods are widely used and may be regarded as of equal utility in nursery work. Budding, however, appears available for a larger number of species.

THE STOCK

The characteristics most desired in a stock are that it be adaptable to the climatic conditions in which it will have to live; it must be capable of making a good and lasting union with the variety; it should be at least as hardy and vigorous as the variety worked on it; it should be resistant to insect and fungous pests; it must be capable of being easily and rapidly propagated at a reasonable cost, so that it can be made available in the desired quantities. In actual practice few of the stocks in use possess all these attributes in the desired degree, and numerous experiments are now under way in search of better stocks. The following brief summary indicates some of the characteristics of the most generally used stocks for the common deciduous fruits.

APPLE STOCKS

Seed from the French crab imported from Europe is used to produce most of the apple stocks in the United States. It is a type of apple little known in this country. The fruit, used extensively in France and Austria for cider making, is characterized by high sugar and tannin content, quite different from our familiar varieties. It has been the chief source of seeds for apple stocks for many years.

Of the domestic seed, Vermont crab from seedling trees of New England is used in limited quantities. Seed from widely grown commercial varieties is being used to an increasing extent during recent years. Seedlings of Tolman Sweet, Oldenburg (*Duchess*), McIntosh, Hibernal, Wealthy, Siberian crab, and Whitney have given evidence of more resistance to cold than the French crab. Other varieties which furnish seed that germinates well and makes vigorous seedlings are Delicious, Stayman Winesap, Jonathan, Ben Davis, and Rome Beauty. So far as they have been tested, they appear to make suitable stocks for general use.

Paradise and Doucin stocks increased by layers are used in propagating dwarf apple trees. These are dwarf European forms which impart their habit of growth to varieties worked on them. Paradise has the most dwarfing effect, while the Doucin is intermediate between that of Paradise and the ordinary apple-seedling stocks.

PEAR STOCKS

French pear (*Pyrus communis*) has been for many years the most generally used and best-known stock for all varieties of pears. Although other stocks more resistant to diseases have come into use, the French pear continues to be more widely used than any other.

It makes strong, lasting unions with all varieties. The roots grow well in the different types of soil. It will tolerate wetter soil and endure more cold than any other pear stock that has been thoroughly tested. The most serious defect of the French pear is its susceptibility to pear blight, the most destructive of pear diseases. The young seedlings are also subject to leaf spot in the nursery. While much of the French-pear seed comes from Europe, large quantities of seed from the Bartlett variety are now being obtained in the Pacific States.

Japan pear (*Pyrus serotina*) also has been extensively used for the past 30 years. Nearly all varieties make good unions with it, and the trees usually make as vigorous growth as those on the French pear. The roots grow well in deep open soils, but are not satisfactory in heavy soils such as adobe or those that are shallow or wet. It is more satisfactory in the Southern States than in the northern pear sections. It will not endure as much cold as the French pear. The young seedlings make vigorous growth and have some resistance to leaf diseases in the nursery, hence are relatively easy to grow. Although it is generally more resistant to pear blight than the French pear, it is by no means immune. Most of the Japan pear seedlings are grown from imported seed in Kansas and the Pacific States.

Pyrus calleryana, a native of central China, has become recognized as a pear stock in recent years. Nearly all the pear varieties on it have made even more vigorous growth than those on French pear, and the unions appear to be strong. It grows well in many different types of soil. Its high degree of resistance to pear blight is one of its most valuable characteristics. It is little affected by leaf diseases in the nursery and usually continues in vigorous growth all season even through periods of dry weather. For this reason it is easy to bud any time during summer. It can not be recommended for cold climates, however, as it has given evidence of winter injury where subjected to temperatures below zero.

Several other oriental species of pears, especially *Pyrus ussuriensis*, have given evidence of desirable qualities and are being made subjects of extensive experiments. Much attention also is being given to the testing and propagating of individual seedlings that have proved highly resistant to pear blight.[3]

The Oregon Agricultural Experiment Station has discovered certain strains and varieties that are not only resistant to pear blight but are desirable as stocks from other standpoints. The use of these selections is increasing in the pear sections of the Pacific States as they become better known.

As dwarfing stocks for pears, the quince is used. The Anjers quince propagated by layers or, under favorable conditions, by cuttings is considered superior to seedlings, though the latter are often used and are obtainable at less expense than layers or cuttings.

CHERRY STOCKS

Most of the cherry trees in the United States are budded on either mahaleb or mazzard stocks. Except in the Pacific States mahaleb is the more generally used.

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[3] REIMER, F. C. BLIGHT RESISTANCE IN PEARS AND CHARACTERISTICS OF PEAR SPECIES AND STOCKS. Oreg. Agr. Expt. Sta. Bul. 214, 99 p., illus. 1925.

Mahaleb (*Prunus mahaleb*) is a native of central Europe. The tree is readily distinguished from mazzard or any other cherry by its small curved shiny leaves and slender twigs. The fruit is bitter, small, and glossy black when ripe. The roots adapt themselves to a wide variety of soil conditions and will endure more cold than mazzard. In the nursery the young seedlings make vigorous and continuous growth. For this reason they can be budded during a long period. Although it is more highly regarded as a stock for sour cherries than for either the sweet or Duke varieties, all three types unite with it and usually make strong growth for the first few years. However, the present evidence indicates that the trees are shorter lived, at least in some sections, than those on mazzard.[4]

Mazzard (*Prunus avium*) is a seedling form of the sweet-cherry varieties. As a tree its appearance is similar to these varieties. In its soil requirements it is perhaps more exacting than mahaleb, but it is adaptable to those of the principal cherry sections, except where severe cold is a factor. The trees make rapid growth and are long lived. In the nursery the young seedlings are vigorous, but their growth is often checked in summer by leaf diseases or drought, making the period for budding uncertain. For this reason the trees on it usually cost more to produce than those on mahaleb. An abundant though little utilized seed supply, superior in quality to that imported from Europe, is to be had from the old wild trees found scattered throughout the Eastern States.

While mahaleb and mazzard seedlings are the only cherry stocks used extensively, several others have been tried, some of which are of local importance. Morello seedlings are sometimes used for sour varieties where extreme hardiness is required. A serious defect of morello is its tendency to sprout from the roots. One form of morello propagated by suckers has been in use for many years in northern Illinois on which sour cherries have proved especially productive and long lived. This or a similar form of it is being used for sweet cherries near Stockton, Calif., as it does well in rather heavy wet soil. In both of these sections the suckers from the roots are dug each year for propagation, hence this habit of suckering is not regarded as a defect.

PLUM STOCKS

Myrobalan (*Prunus cerasifera*) is the most generally used stock for the principal varieties of plums. It makes strong lasting unions, and nearly all varieties on it develop into large smooth trees in the nursery. Its roots adapt themselves to many different soil types. Though the seedlings are usually vigorous, the individuals vary greatly in size and color of fruit, size of pits, time required for germination, rate of growth, and the form of the seedling trees. In California, where most of the domestic seed supply is grown, improvement is being brought about by the selection of the best strains for stocks and growing these strains for their seed. It will not endure as much cold as some of the other species, but is sufficiently hardy for most sections where plums and prunes are important crops.

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[4] HOWE, G. H. MAZZARD AND MAHALEB ROOTSTOCKS FOR CHERRIES. N. Y. State Agr. Expt. Sta. Bul. 544, 14 p., illus. 1927.

St. Julien (*Prunus insititia*), a European plum, is a stock preferred by some plum growers for the European varieties. They find that long-lived vigorous trees free from suckers may be obtained when these varieties are budded on it. Its use is limited, possibly because the seedlings are not always available in the market, and they are usually a little higher in price than other plum stocks.

Prunus americana, a widely distributed native plum, is frequently preferred where resistance to cold is a factor. It is regarded as an especially good stock for the native plum varieties. It will unite with European and Japanese plums also, but with these types it is less certain than myrobalan.

Marianna, a variety readily propagated from hardwood cuttings, is often used, particularly in the Southern States.

Peach seedlings are used to some extent for Japanese plum varieties in the Pacific Coast States. In some places they are preferable to the plum, as the peach roots succeed better on the drier soils.

PEACH STOCKS

For the eastern and central parts of the country, the principal supply of peach pits is obtained from the wild or half-wild trees growing in the mountainous parts of Kentucky, Tennessee, and North Carolina. These pits are small in size, averaging from 6,000 to 7,000 per bushel. The supply of these "natural" or seedling pits is diminishing, on account of the passing out of many of the old trees. For the Pacific Coast States the main supply comes from the peach varieties used for drying, such as Salwey, Lovell, and Muir. A wild peach from China, *Prunus davidiana*, makes good unions with peach varieties and has proved more tolerant to alkali soils than any of the other forms of peach used for stocks.

APRICOT STOCKS

Pits from apricot varieties are the principal source of stocks for this fruit. Myrobalan plum is used also, especially where the trees are to be grown on heavy soil. Peach seedlings commonly fail to make good unions with apricot. The Japanese apricot, *Prunus mume*, is being tried as a stock in California because of its resistance to the armillaria disease or oak-root fungus.

GRAFTING

SELECTION AND TREATMENT OF SCION WOOD

Wood of one season's growth is preferable to older wood because unions with it are more easily made and the buds are more likely to grow. Twigs that have made a vigorous growth of 12 inches or more in the last season are usually the best, though shorter ones if well matured may be used with good results. Although scion wood is ordinarily taken from bearing trees, nurseries that make grafts in large quantities frequently maintain apple and pear trees of the desired varieties for the special purpose of supplying such wood, giving these trees special attention to encourage the growth and to keep them free from pests. Such trees supply an annual crop of smooth straight twigs.

Scion wood is usually cut in late fall, after the leaves have fallen, or during winter. If no danger of winter injury exists the wood may be left on the trees until later and cut when it is to be used. It should not be cut or handled, however, while in a frozen condition. When taken in advance of the time of grafting, it is made into bundles, labeled, and stored in a cool cellar packed in slightly moistened sphagnum moss or sand. If a suitable cellar is not available it may be kept in good condition by simply burying it in a pit located in a well-drained place. When the wood is made into scions the tip ends are usually discarded.

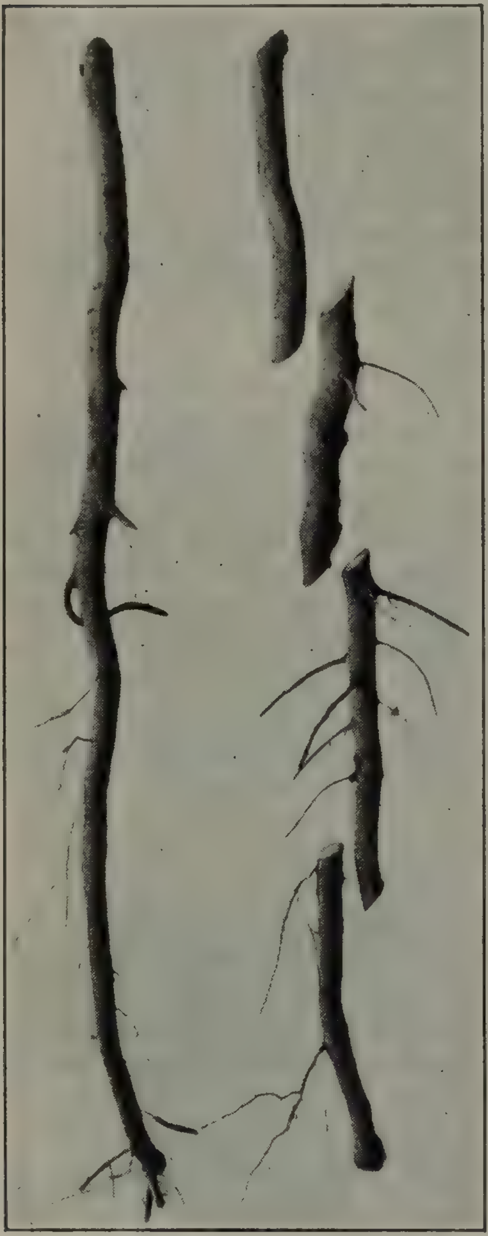

FIG. 16.—Long apple root cut for piece-root grafts

THE UNION

Grafts may be classified according to the position on the stock where the union is made. They are termed root grafts when made on root tissue, crown grafts when on the stem near the ground level, stem grafts when made high on the stem, and top grafts when made on the branches.

Unions may be made in a multitude of ways, but in actual practice comparatively few are simple and rapid enough to meet the demands of general use. Of these the whip graft, cleft graft, splice graft, bark graft, and veneer graft, with various modifications, have application in propagating fruit and ornamental trees.

METHODS OF GRAFTING

WHIP GRAFT OR TONGUE GRAFT

The whip or tongue graft, also called bench graft because the work is done indoors at a bench or table, is the method in common use for root grafts of apple and pear, as well as for some ornamentals. It is a particularly desirable method for species which unite easily and where stock and scion are nearly the same size. The grafting is done during the winter, when the scions and stocks are dormant.

The entire root may be used for a single graft, to make a whole-root graft, or it may be cut into portions to make piece-root grafts. For whole-root grafts, seedlings with branched or stubby roots are preferable; for piece-root grafts, long straight roots with diameters as large or a little larger than the scions are selected, each root furnishing two or more pieces about 3 inches in length. (Fig. 16.)

Whole-root grafts usually make somewhat larger trees the first year than piece-root grafts, owing to the larger root, but in their subsequent development no material difference in the two styles of grafts is observed.

For making grafts efficiently, a knife with a thin stiff straight blade that will hold a keen edge is necessary. Figure 17 illustrates one form of grafting knife suitable for the purpose.

The scion, 3 to 6 or 8 inches in length, is prepared by cutting off the lower end diagonally with a single stroke of the knife, making a flat surface about 1¼ to 1¾ inches long. If the knife is held at an acute angle with the scion while making the cut, as shown in Figure 18, it is easier to make the cut surface smooth with straight edges than if held at a right angle with the scion. A cleft is then made, starting a little back from the tip of the cut surface and running back about half its length to form a thin "tongue." (Fig 19, A.)

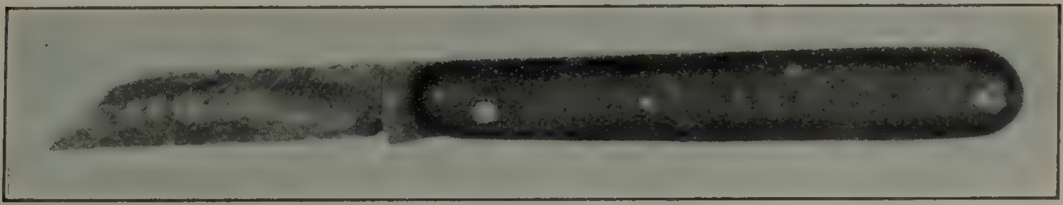

FIG. 17.—Grafting knife

The upper end of the stock is prepared correspondingly. If the stock has branching roots they are trimmed to stubs. The stock and scions are then joined together as shown in Figure 19, B, care being taken that the inner bark (cambium layer) corresponds at least on one side.

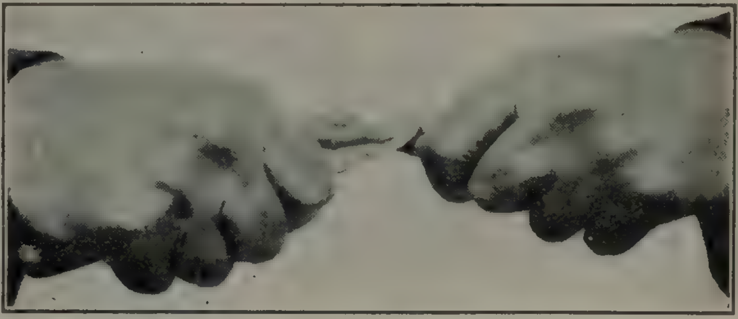

FIG. 18.—Cutting the scion

The two parts are held in place with several wraps of No. 20 or No. 30 crochet cotton or similar light twine (fig. 19, C), previously prepared by dipping the balls into melted grafting wax for a few minutes. When they have become impregnated with the wax they are allowed to drain and cool. When in use the ball of waxed cotton is placed in water kept warm by a small kerosene stove or lamp, so that the twine is soft and pliable. Each turn of the twine around the graft should be drawn as tight as possible without cutting into the bark. When the graft has been wrapped the twine is simply broken off, no knot being needed to hold it in place. (Fig. 20.) Raffia or some form of light tape to cover the entire wound is sometimes preferred, although a little slower to put on than waxed thread or twine. Such a bandage helps to protect the cut edges from infection. Heavy twine or other durable material is objectionable because it may not decay in time to avoid constricting the graft after growth has started.

If the work is done in a fairly cool room where the air is slightly moist the scions and stocks can be exposed an hour or two without injury. Care must be taken, however, to prevent the material from drying.

To obtain well-made grafts, the stocks should be at least as large or a little larger than the scions. The two parts should be fitted with care, especially the lower tip of the scion, and wrapped to hold the parts firmly.

Storage of whip grafts.—Immediately after the grafts are made they are tied in bundles and packed in boxes with slightly moistened sphagnum moss or sawdust to keep them fresh. Clean moist sand also is a good packing material, but it makes the boxes heavy to handle.

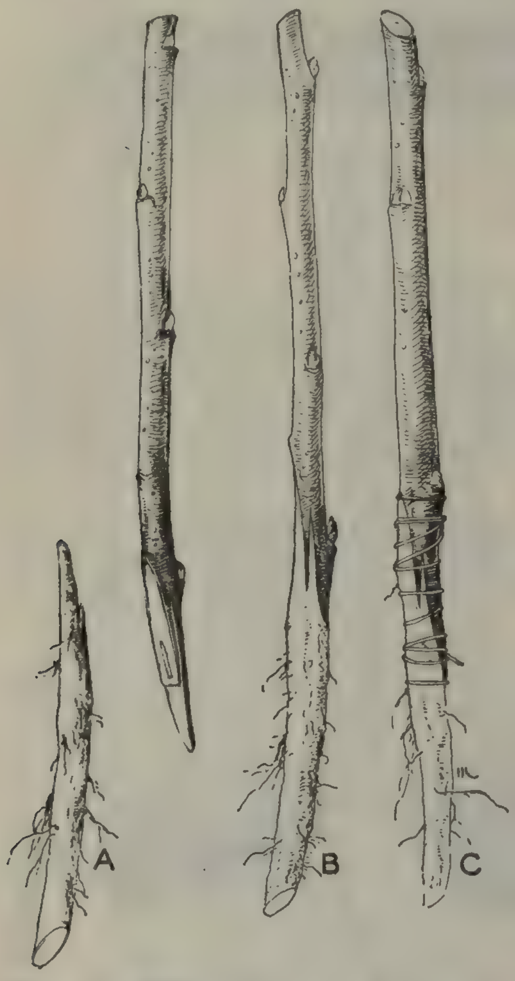

FIG. 19.—Whip graft. A, Scion and stock prepared; B, fitted together; C, wrapped with waxed twine

Grafts are commonly stored in a cool cellar, preferably where a temperature of 40° or 45° F. can be maintained. The first activity to be noticed is the formation of a spongy outgrowth of callus along the edges of the union. The stored grafts should be examined from time to time, and if any mold appears they should be unpacked and exposed to the air of the cellar for a few hours to dry and then repacked in slightly drier, clean material. If growth is found to be starting from the buds the scions should be stored in a cooler place or else planted.

Nursery care of whip grafts.—Fertile, well-drained soil and good culture are requisites for the production of trees from grafts. The value of the trees depends in large measure on the size they attain during the first year or two, hence the need for favorable conditions to secure maximum growth.

The grafts are planted as early in spring as the ground can be worked properly, while the scions are still dormant. They are usually spaced about 6 or 8 inches apart. Care is taken that the union and most of the length of the scion is underground, only the top bud remaining above the surface. The soil should be pressed firmly around the roots without disturbing the union.

During the early part of the season is the time to encourage as rapid growth as possible. If the grafts get a vigorous start in spring they are much more likely to produce good trees the first season than if checked for any reason. Frequent cultivation and weeding are necessary at first.

As growth develops the lateral shoots are kept pinched out without disturbing the leaves of the main stems, to force all the growth into the terminal bud until the main stem has reached a height of perhaps 30 inches. In localities where a long-growing season permits unusually large size, the tip may be cut off when the desired height for the trunk has been reached and the trees allowed to branch. In the Northern and Central States the trees are more commonly kept to a single stem the first season. If they make a growth of 3 or 4 feet the first season they are of desirable size for orchard planting. When kept in the nursery the second season to develop branched tops they are cut back to a uniform height, usually 24 to 30 inches, before growth starts. This cutting back induces branching at the desired height. Apple or pear grafts that make less than 2 feet of growth the first season are of much less value than those of more vigorous growth.

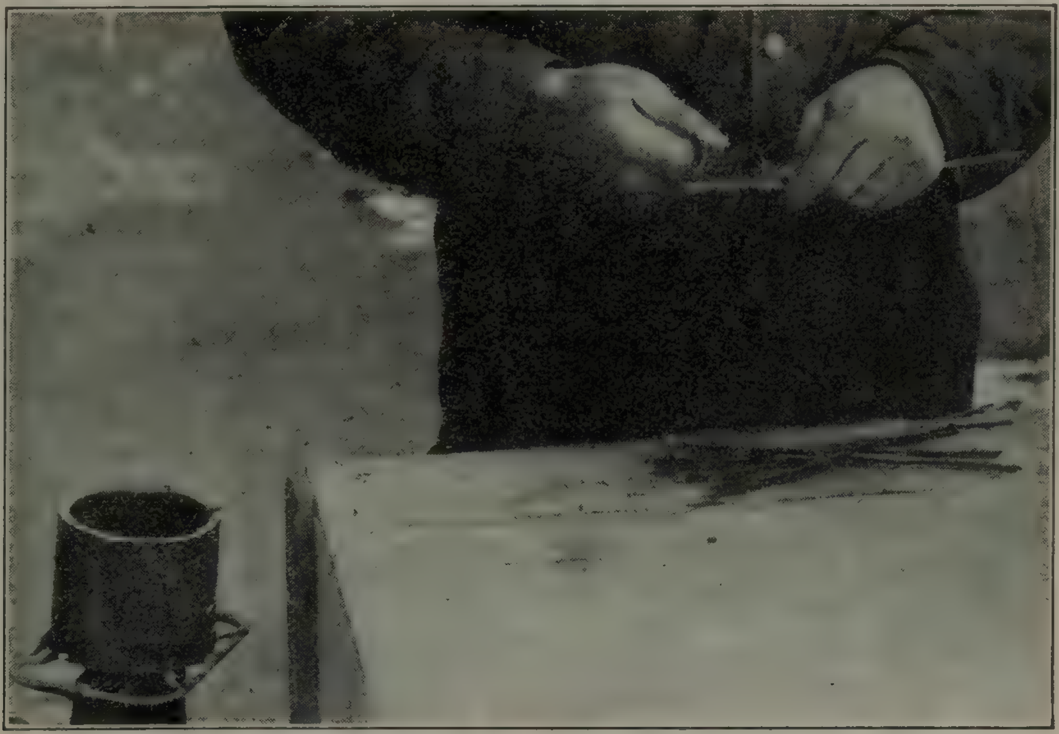

FIG. 20.—Wrapping whip grafts with waxed twine

CLEFT GRAFT

The cleft graft is often used for grafting in the open, especially when the stock is larger than the scion. (Fig. 21.) The work is done in the late winter or early spring while the scions are still dormant, and usually the stock is dormant also. However, in top grafting, as in the case of an apple tree, it is not a disadvantage

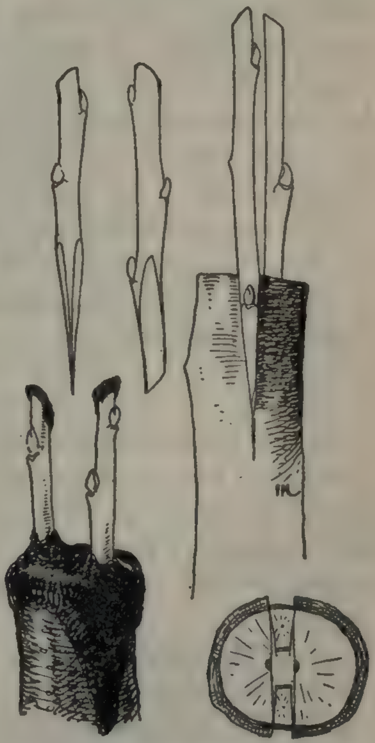

FIG. 21.—Cleft graft. Scions prepared, set in place, and waxed

if the tree has started growth. The stock is cut off at the place where the union is desired. A cleft is then made in the end of the stub with a grafting tool having a curved edge and a wedge-shaped face, as illustrated in Figure 22. The object of the curved edge of this blade is to avoid tearing the bark at the end of the stub. The cleft is held open by the wedge-shaped prong on the grafting tool while the scion is being inserted. Though this tool is a labor-saving convenience, the cleft can be made satisfactorily with a broad chisel or similar blade if carefully used. The cleft can be held open to receive the scion by the use of a wooden or metal wedge.

The scion is made from a portion of the previous season's growth, usually of such length as to include three buds. It is advisable to cut it so that the lower bud will be on the outside near the end of the stock. The lower end of the scion is wedge-shaped, the surfaces being about 1 to 1¼ inches long with the outer edge a little thicker than the inner so that when the wedge is removed and the cleft closes against the scion more pressure is applied where the cambium layers are joined. To make the contact of the inner bark still more certain, the scion is often set at a slight angle with the stock, so that the cambium layers cross. If the stock is large enough, a scion should be set on each edge of the cleft, to increase the chance of obtaining at least one good union. Both scions should be of the same size. Ordinarily it is not necessary to tie the union, the pressure of the stubs being sufficient to hold the scions in close contact. When set, all the cut surfaces including the tip end must be covered with grafting wax. If both scions grow, one should be removed within the succeeding year or two.

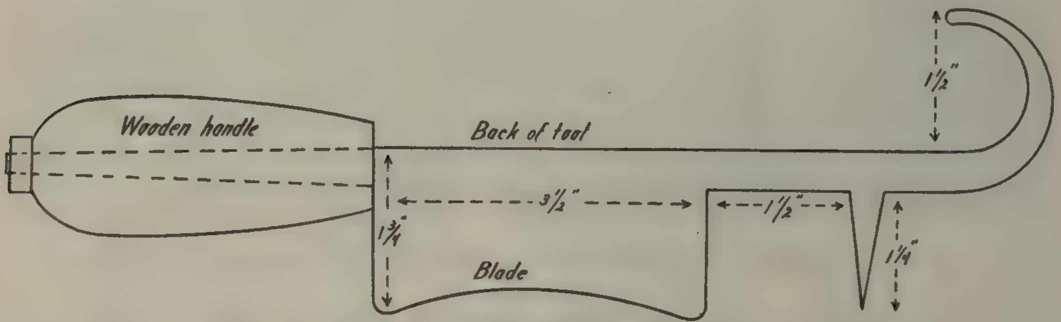

FIG. 22.—Tool for cleft grafting

BARK GRAFT

Bark grafts, (fig. 23) with several modifications, are also frequently used for outdoor work when the stock is larger than the scion. The work is done in the spring after the sap rises, so that the bark can be separated from the wood easily, but while the scions are still dormant. The stock is cut off as for the cleft graft. A lengthwise cut about 1½ inches long is made through the bark downward from the end of the stub. (Fig. 23, B.) The scion is shaped with a shoulder (fig. 23, A) and inserted under the bark, care being taken that the bark is loosened only enough to admit the scion, which is held firmly in place by bandaging with twine or by the use of slender brads about half an inch in length. If the union is above ground all the cut surface must be waxed to exclude the air. Another way of making a bark graft is illustrated in Figure 24.

GRAFTING WAX

Grafting wax to apply with the hands may be made by melting together 4 parts of resin, 2 parts of tallow or linseed oil, and 1 part of beeswax. While hot the liquid mixture is poured into a vessel of cold water and when hardened sufficiently to handle it is taken out and pulled and worked until it has a light-yellow color. It may be kept in convenient form for use by wrapping in oiled paper. While applying it the hands should be kept greased with tallow. The wax may be applied with a brush if kept in a semiliquid state by heating. Care must be taken, however, that it is not applied hot enough to injure the tissues. It is frequently used for waxing the twine used for wrapping grafts.

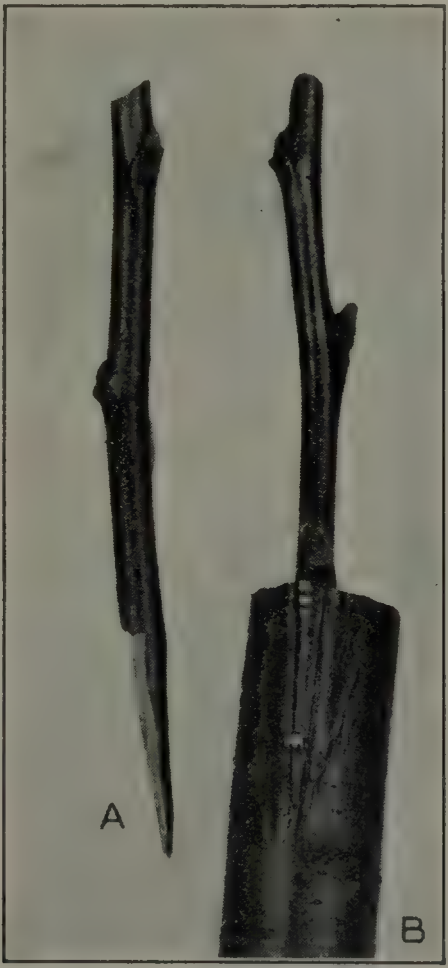

FIG. 23.—Bark graft. The scion (A) is cut with a shoulder. The bark of the stock (B) is cut and the edges raised to admit the scion, which is held in place by two brads about one-half inch long. All cut surface should be waxed

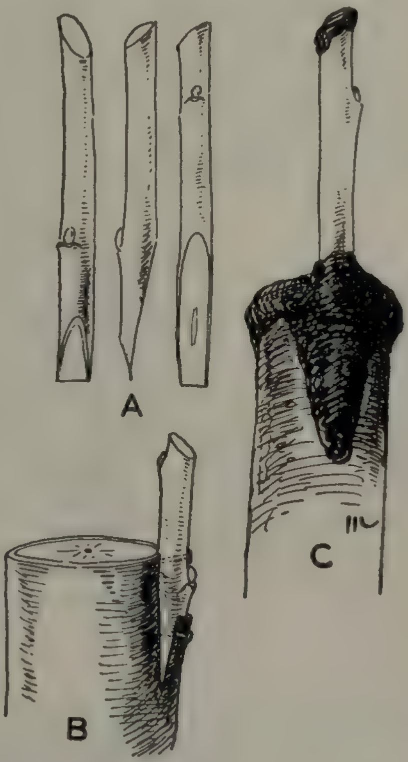

FIG. 24.—Bark graft. A, Scions made by slanting cuts without a shoulder; B, stock prepared by taking out a piece of bark to admit the scion; C, the complete graft with all the cuts waxed

Another grafting wax regarded as more durable than that described above is made with 5 pounds of resin and 1 pound of beeswax. When these ingredients are melted, one-fourth pint of linseed oil is stirred into it, and the mixture is then removed from the fire, after which one-half pound of lampblack or powdered charcoal is worked into it a little at a time. Adding the ingredients separately lessens the danger of fire, which would be likely to occur if the mixture boiled over. This wax is intended to be applied with a brush while kept soft by heating.

GRAFTING UNDER GLASS

Because grafts of evergreens and certain deciduous trees valued for landscape planting do not unite quickly enough to succeed well under outdoor conditions, some form of glass-covered inclosure or "grafting case" inside a greenhouse is necessary to give the grafts proper conditions for uniting. This method of propagation, being relatively expensive, is utilized in a practical way for only the comparatively few varieties that are slow and uncertain to root from cuttings. Some of these, however, are especially desirable and valuable, including the named varieties of spruce, pine, rhododendron, Japanese maples, and others. At the present time most of the grafting of evergreens in this country is done where specially equipped greenhouses are provided and such grafting is not often attempted by unskilled growers. The frequent queries received by the Department of Agriculture, however, indicate considerable interest in the methods employed.

GRAFTING CASE

Inclosures inside a greenhouse suitable for the grafts may be made in several ways. An ordinary greenhouse bench piped to supply bottom heat may be utilized. A bench in the middle of the greenhouse is usually preferable to a side bench, because the light is more uniform. The sides of the bench are made of boards 12 to 15 inches in height over which are put glass sash, or light glass bars may be fitted across to support panes of glass, thus providing a level glass top which admits the light freely but confines the air.

STOCKS

Seedlings of the same or closely related species as the varieties to be propagated are used for stocks. They are grown in beds, as previously described under "Coniferous seedlings," until their stems are of suitable diameter for grafting, about two-sixteenths to three-sixteenths of an inch, preferably a little larger than the scions to be worked on them. The stocks are potted in early fall and kept in a cool greenhouse or in a frame protected from freezing. By midwinter, new roots having formed, the stocks are in condition to start growth quickly. They are brought into a heated greenhouse two or three weeks in advance and are ready to graft as soon as a little growth has started.

GRAFTING

Grafting is done during January and February. The union made on the stem by what is termed a side graft is used. Scions are taken from the dormant trees outside when they are to be grafted, the vigorous twigs from the terminals of branches being selected.

The veneer graft illustrated in Figure 25 is a form of side graft frequently used for evergreens. The union is made in the stem of the stock just above the pot. The stock is prepared by cutting out a thin wedge-shaped section about 1 inch long, as shown in that figure. The lower end of the cut extends into the stem a distance equal to about one-third of its diameter. The lower end of the scion is cut off diagonally and the end trimmed to correspond with the opening in the stock, so that when put in place the cambium layer or inner bark matches on the lower end and at least on one side. If the cuts are so made that the inner bark can be matched on both sides the chances for a perfect union are increased. The union is tied firmly with waxed twine or with raffia. No wax is used over the union. The stock above the union is left intact.

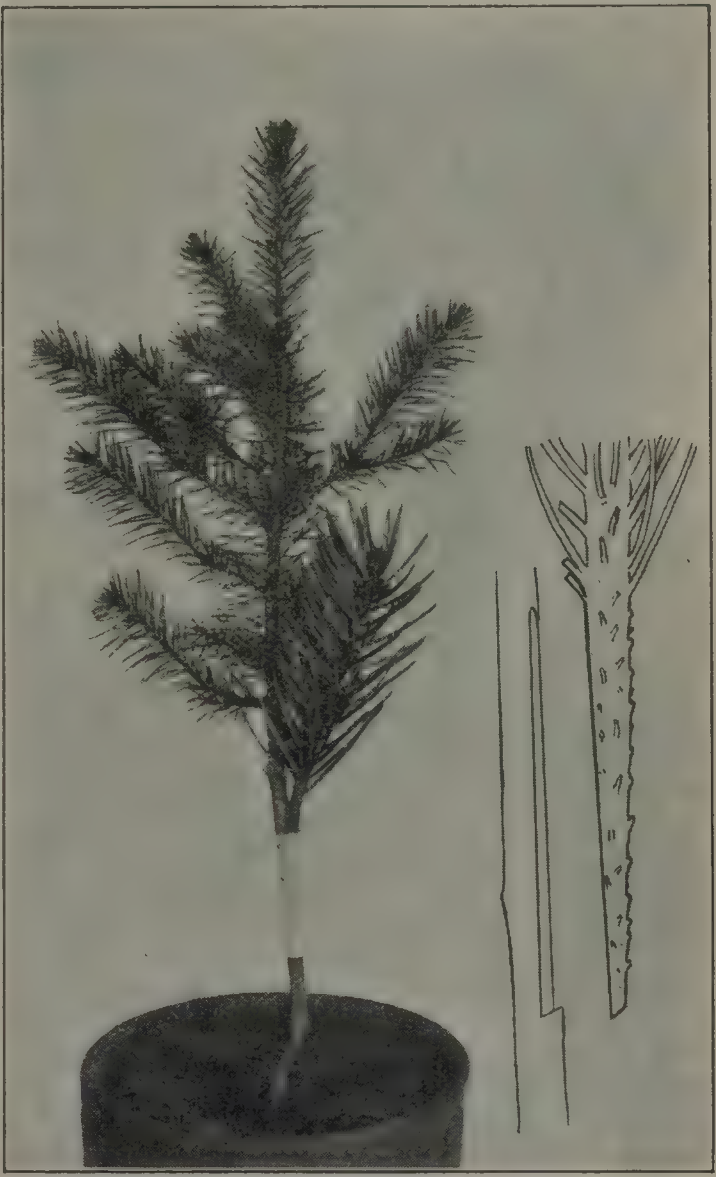

FIG. 25.—Veneer graft for evergreens

Another form of side graft, preferred by some for slender stems and scions, such as junipers, is illustrated in Figure 26. A downward cut is made in the stock, about 1½ inches long, running just inside the wood but not slanting inward as for the veneer graft. The scion is prepared by paring off about one-fourth its diameter from each side to fit the opening in the stock, leaving the sides nearly parallel. The lower end is cut off at a slant, making the end chisel shaped. The scion is fitted with the longer side next to the stock, and the flap of bark on the stock is brought over the end and along the side of the scion. It is firmly tied, as described for the veneer graft.

CARE OF EVERGREEN GRAFTS

The sides and bottom of the grafting case should first be whitewashed to aid in keeping it free from mold. The pots are laid in an inclined position with the graft uppermost in the case, and moss is packed around the pots to keep the soil moist. The leaves of both stocks and scions should be kept from contact with the moss to lessen the danger of decay. The case is kept closed except for a short period for ventilation each day. For evergreens a night temperature of about 60° F. in the grafting case is desirable. A lower temperature may be used satisfactorily, but wide fluctuations should be guarded against. After about three or four weeks part of the top of the stock is cut off to divert the growth gradually to the scion. After another four weeks the remainder of the stock is cut away just above the union and the plants are brought out of the case and put on a greenhouse bench.

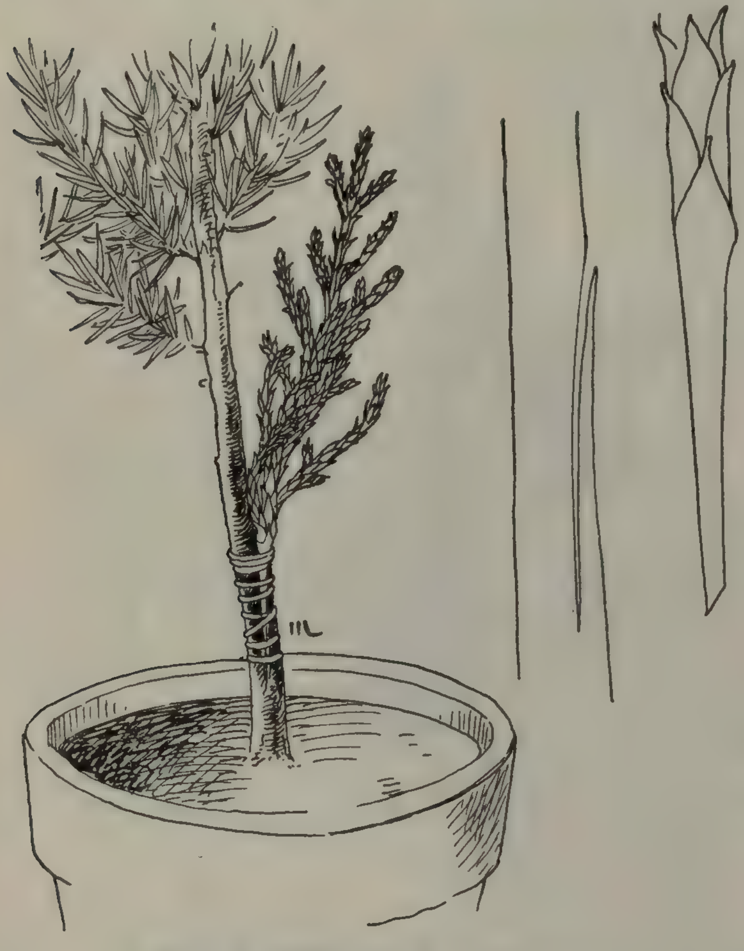

FIG. 26.—Side graft for evergreens

During the summer the plants can be shifted out of the pots into frames. At first they are easily injured by drought or hot weather, and they should therefore have protection from full sunlight and from wind. Overhead irrigation is valuable in keeping the plants cool as well as supplying the necessary moisture.

BUDDING

Budding is one of the most economical modes of propagation for certain kinds of deciduous woody plants, reproduction being by means of a single bud of the variety instead of three or more buds usually included on a scion in grafting. The operation can be done speedily by a skilled workman.

PLANTING AND PREPARATION OF STOCKS FOR BUDDING

For ordinary field budding of cherry, plum, quince, apple, pear, and such ornamental plants as roses and lilacs, 1-year-old stocks are planted in early spring. The roots are trimmed back to 6 or 8 inches so that they can be readily planted without bending them out of their natural position, as an aid in developing well-branched shapely root systems. (Fig. 27.) The tops are cut off about 12 inches above the ground. The plants are spaced 5 to 10 inches apart in rows about 4 feet apart to allow space for horse cultivation.

Fruit-tree stocks, which are usually budded on the stem just above the ground, are planted with the crown 1 or 2 inches below the ground level. Seedling rose stocks, which should be budded on root tissue just below the crown, are easier to bud if planted with the crown a little above the ground level, then protected by a ridge of soil 3 or 4 inches high, which is drawn away at the time of budding.

For peach and apricot stocks, the pits are planted in the fall or early spring in the rows where the young trees are to be budded, because they attain sufficient size to be budded during the first year's growth.

During the early part of the season the stocks should receive good culture to promote vigorous growth. Care to avoid injury to the bark on the stems is necessary in hoeing and cultivating the young trees. At budding time the stems should be about the thickness of a lead pencil, though smaller ones can be budded. Stems more than five-eighths of an inch in diameter are usually harder to bud because of the thick bark and difficulty in tying the buds firmly. At the time of budding, the leaves and twigs within 6 or 8 inches of the ground are removed so that the buds can be placed on smooth, clean stems.

SELECTION AND PREPARATION OF BUDS

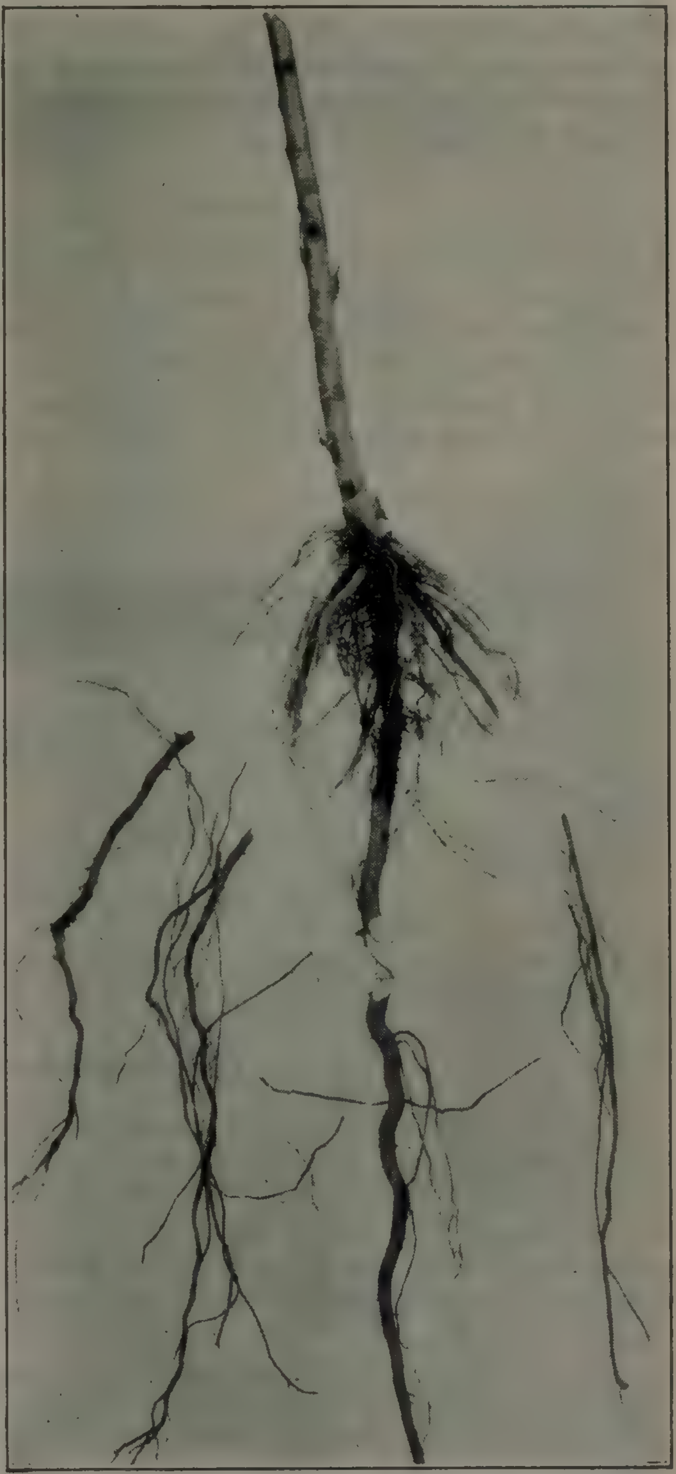

FIG. 27.—Branched root apple stock trimmed for planting

The buds used for propagation are taken from wood of the current season, after growth has progressed so that those on the middle portion of the twigs or "bud sticks" have fully developed. Peach trees often bear a cluster of three buds at each leaf on the lower part of the twig, which should be discarded unless buds are scarce; if used, the two outside ones or flower buds should be rubbed off, leaving the middle or branch bud. Those near the tip of the twigs of most kinds of trees are likely to be too immature. Generally the four or five along the middle portion of the twig are the best to use.

At the time the bud sticks are cut, the leaves are trimmed off, leaving about a quarter of an inch of leaf stem to protect the bud and to aid in handling it. It is advisable to cut the buds at the time they are used, but if necessary they can be kept fresh for two or three days wrapped in wet burlap or paper or buried in a shady place. They can be kept for a longer period if properly packed and stored on ice.

SEASON FOR BUDDING

The time for budding is during July, August, and September, when the buds have sufficiently matured and the stocks are making active growth so that the bark peels easily. Some stocks, such as the mazzard cherry and French pear, may stop growth by midsummer, making their budding season short; others, such as the peach, can be budded over a longer season. Generally it is useless to bud if the bark is so tight that it must be lifted forcibly, exposing a dry, fibrous condition in the cambium layer.

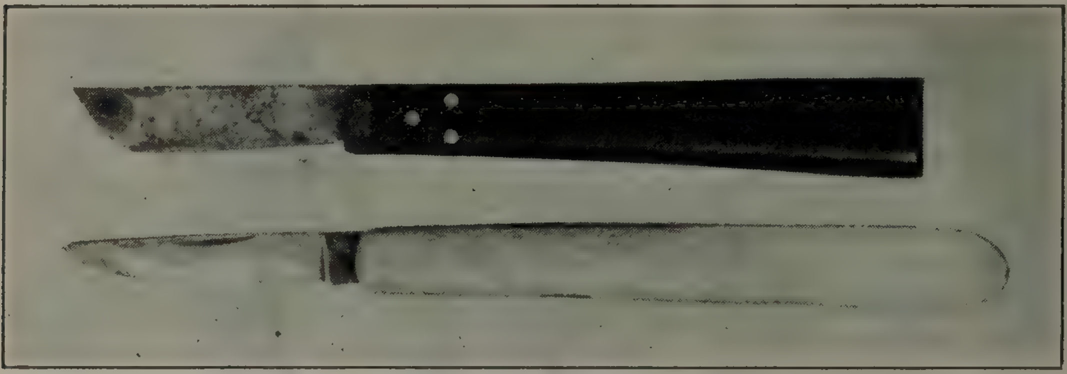

FIG. 28.—Two styles of budding knives

BUDDING KNIVES

A good budding knife has a thin blade which ends in a curve on the cutting edge. Handles are made in several different shapes, two of which are shown in Figure 28. A plain straight handle is good for trees that have tough bark which peels easily; a bone handle with a flat end to lift the bark without injury is best for roses and trees with thin tender bark. While in use the knife must be kept very sharp.

SHIELD BUDDING

Shield budding with several modifications is the most widely used method of budding. The bud is pared from the twig in the form of a shield to include a portion of the bark above and below it and a thin shaving of wood underneath it. This bit of wood is sometimes removed, but ordinarily it is disregarded. The bud is inserted into a matrix under the bark of the stock made by two cuts—one along the stem, the other across it.

The manner of operating varies among different budders. One efficient method for fruit trees whose bark peels easily is illustrated in Figures 29 to 34. The bud is put preferably on the north side of the stock in order to shade it. The first cut on the stock is made lengthwise of the stem; next the crescent-shaped crosscut (fig. 30) is made with a rolling movement of the knife which lifts the corners of the bark where the two cuts cross each other. If the bark does not separate easily enough to admit the bud without injury by the method just described, it is raised along the cut edges with the point of the knife or the flat end of the handle, as shown in Figure 31. Then the bud is cut from the stick (fig. 32), holding the knife at an angle to assist in making the edge straight and smooth, and is held on the blade of the knife with the thumb until pushed down into place in the matrix, as shown in Figures 33 and 34. If the bark at the top of the shield projects above the matrix it should be cut off evenly, so that all the cut surface under the bud fits snugly against the wood of the stock.

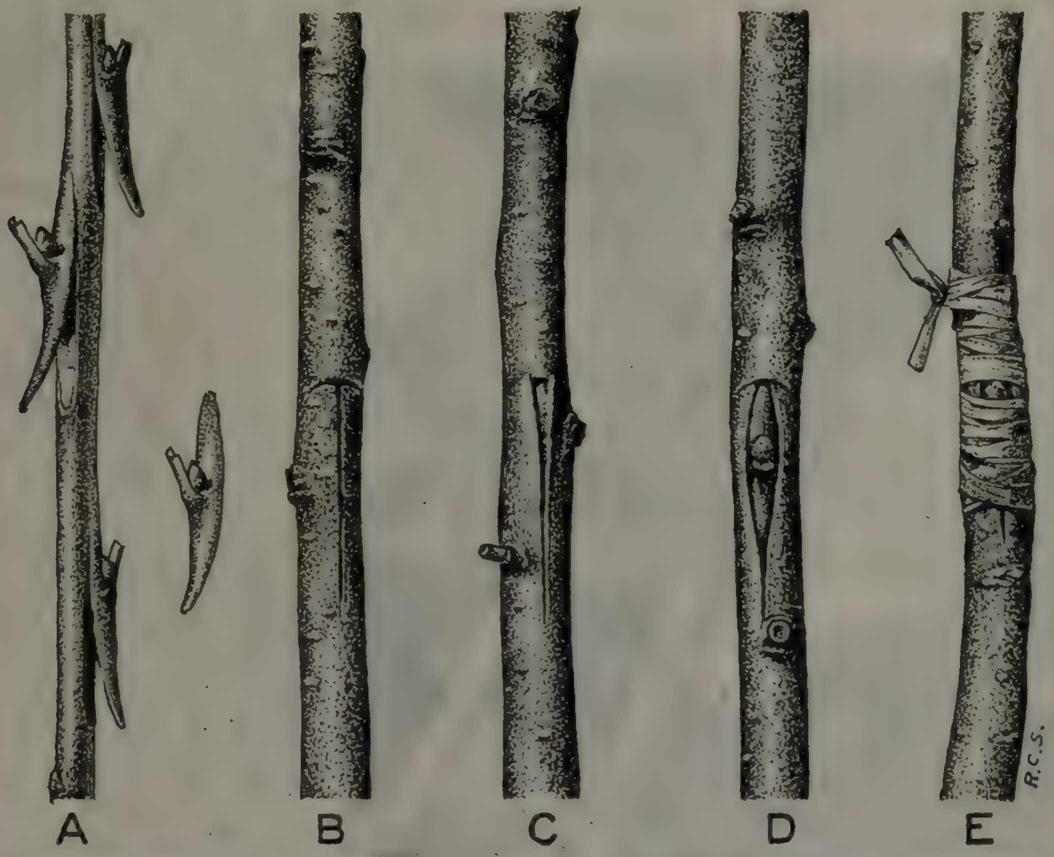

FIG. 29.—Shield bud. A, Bud stick; B, T-shaped cut through the bark of the stock; C, bark raised to admit the bud; D, bud in place; E, bud wrapped with raffia

The operation is completed by tying the bud in place. Several different materials are in use for the bandages. Light cotton twine cut into lengths sufficient to allow six or eight turns around the stock is often used for fruit trees. Many budders prefer raffia, which is kept moist while in use so that it is soft and pliable. Light bands made from a special grade of rubber have come into use in recent years for fruit trees because they maintain constant pressure and expand with the growth of the stock. In some cases muslin that has been dipped into melted paraffin or beeswax is preferred.

The manner of wrapping the buds also varies among different operators. One way much used is to begin the wrap just below the bud, making the end lap under the first course to hold it. (Fig. 35.)

For most kinds of fruit trees three or four wraps of twine both below and above the bud are sufficient; for roses and other plants easily injured it is better to use raffia or other material that will cover the entire wound, leaving only the bud exposed. The tie may be made above the wound by lapping the end under the last course and drawing it tight, as shown in Figure 36, or by tying a knot. Irrespective of the method used, the wrapping must be such that the bud is held securely at all points against the stock.

THE JONES METHOD OF BUDDING

A mode of budding which was called to the attention of workers in the United States Department of Agriculture by the late J. F. Jones,[5] of Pennsylvania, is very simple and can be used rapidly. In comparison with ordinary shield budding during the last three seasons this method has given very good results.

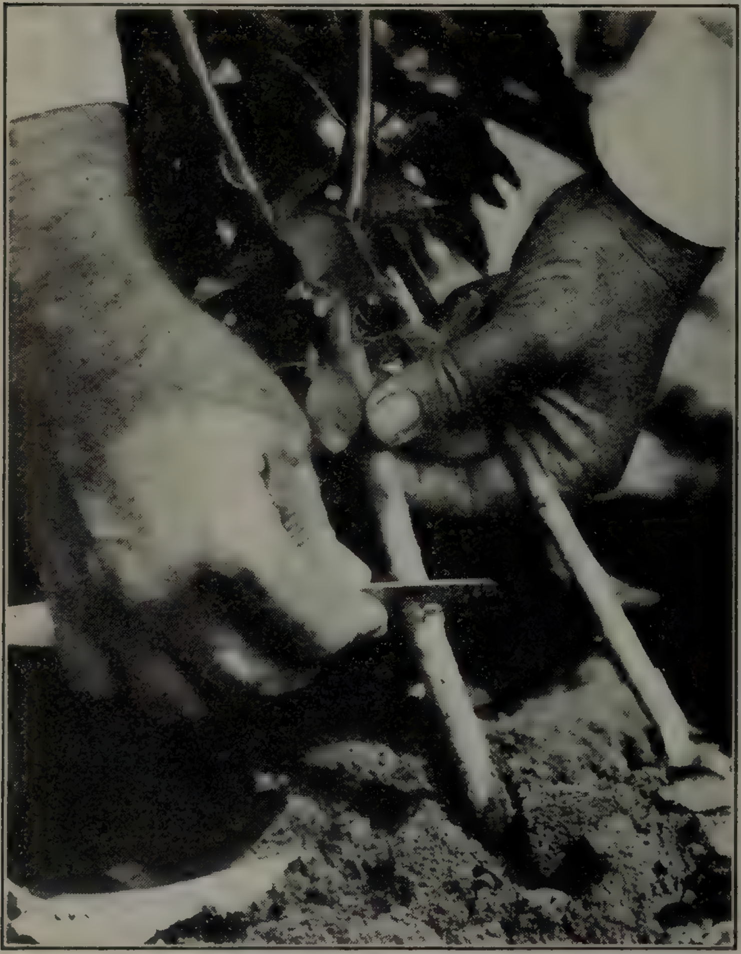

Fig. 30.—Making the crosscut in the stock

A section of bark about 1½ inches long is pared from the side of the stock by a single downward stroke of the knife, exposing but not cutting into the wood beneath. The upper part of the piece of bark is cut off, leaving the lower portion attached to the stock. (Fig. 37, A.)

The bud is cut as for the ordinary shield bud, or perhaps a trifle thicker, and placed against the cut surface of the stock in the position shown in Figure 37, C, the flap of bark on the stock serving to hold the bud until it is tied. Muslin dipped into melted beeswax and then

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[5] Mr. Jones, under date of Feb. 2, 1927, wrote as follows:

"Answering your letter relative to the method of budding that I showed you, this was original with me. As I told you, it might not have been new—some one might have used it previously—but if so I had no knowledge of it; neither have I up to this date.

"I first used this in 1895. I do not recollect using it on anything but chestnut that year. In these initial experiments the bark was cut down, the cut being made about one-half inch longer than required for the bud, the bud pushed down and the bark lapped over it and tied with wrapping twine. My idea was that with difficult subjects, like the chestnut, which callus slowly, the bark would unite with the stock at the top and, being connected with the stock top and bottom, would remain green long enough to hold the bud plump till a union could take place. We made the first rather extensive use of this method in budding at Mountain Grove, Mo., in 1900, when 22,000 peaches were budded torn into narrow strips about 8 inches long is preferred for the bandage, though raffia may be used.

CARE OF BUDDED TREES

The bandages are allowed to remain until the tissues have united, but should be cut before they seriously constrict the stocks. In the case of fast-growing stocks, such as peach, they should be cut 10 days or two weeks after budding, while they may remain a month or more or even until the following spring on slow-growing stocks without injury. When the bandages are cut, the buds that have "taken" may be distinguished easily by their fresh, plump appearance. If some have failed they may be rebudded at this time. Ordinarily the buds are intended to remain dormant the season they are inserted and grow the following spring.

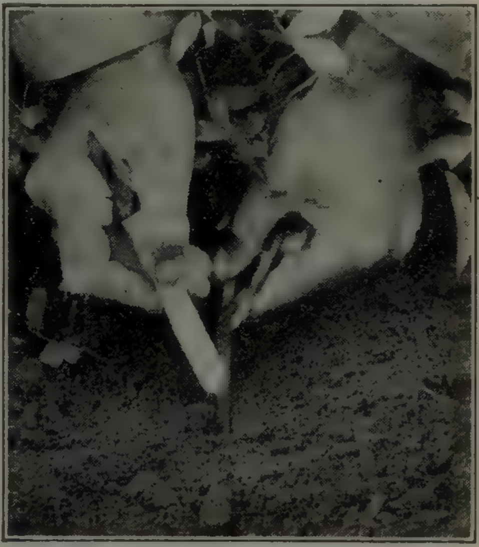

FIG. 31.—Lifting the bark with the flattened end of the knife handle

About the time that growth starts the following spring, the tops of the stocks are cut off just above the buds. Figure 38 illustrates the sloping cut so made that new growth will soon cover the wound.

The result of one season's growth of a stock that has been properly cut off just above the bud with the wound nearly healed is shown in Figure 39, A, while one that has been cut off too far above the bud with the disfiguring stub remaining is shown in Figure 39, B.

At intervals during the first few weeks of active growth all the sprouts arising from the stock around and below the bud must be removed, as such growth would soon smother the buds. If the young trees are to be grown as "whips," all the side or lateral shoots from the growing bud are pinched out wherever they appear, without disturbing the leaves on the main stem. Apple and pear trees are often so treated. If branched trees are desired, as is usually the case for peach and plum, the laterals are pinched out during the early part of the season or until the stems have reached the required height. Laterals subsequently formed are allowed to develop in a natural

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late in October after the sap was practically gone and the bark set on most of the stocks. As in previous tests on fruit trees, we secured a good stand on buds in this block. With the exception of the chestnut, where the bark was thick and heavy, the bark lapped over the buds did not remain green for any great length of time, directly over the bud, although it united with the stock at the top, yet in most cases it had to be cut away to release the bud and to ascertain if the buds had taken.

"Subsequent trials in budding, cutting away the bark, and wrapping with waxed muslin proved just as effective, and we have practiced this since. I have used this method entirely with fruit trees for a good many years, as it is easier and quicker and we think we get better stands of buds, at least with cherry. The mazzard cherry, considered one of the most difficult fruit-tree stocks to bud, we have budded here as late as October and secured good stands of buds. The work of budding is much easier on sappy stocks and of course results are more sure, but with careful work and the use of waxed muslin in wrapping the buds any of our more common fruit trees can be budded successfully after the sap is gone and the bark set, provided, of course, the buds have time to make a good union with the stock before freezing weather sets in, as is generally the case where premature hardening of the stocks is caused by drought; but the budwood must also be well matured and ripened. Sappy budwood will not give results on dry stocks."

manner to form a branched top. If shrubby low-branched plants are wanted, lateral branches low on the stem are encouraged by pinching or cutting back the terminal of the main shoot early in the season while the wood is still soft. This treatment is especially desirable for hybrid tea roses, not only to increase the number of low branches but to lessen the danger from wind, which often causes loss by breaking off the long tender shoots before the wood has hardened.

The culture of budded trees should be such as to encourage rapid growth. Much of the future value of the trees depends on thrifty growth the first season. Trees that have attained a good size as a result of culture in the nursery may be expected to succeed far better than those that have been checked or stunted. Nearly all trees should make sufficient growth from the bud in one season to fit them for transplanting to their permanent location.

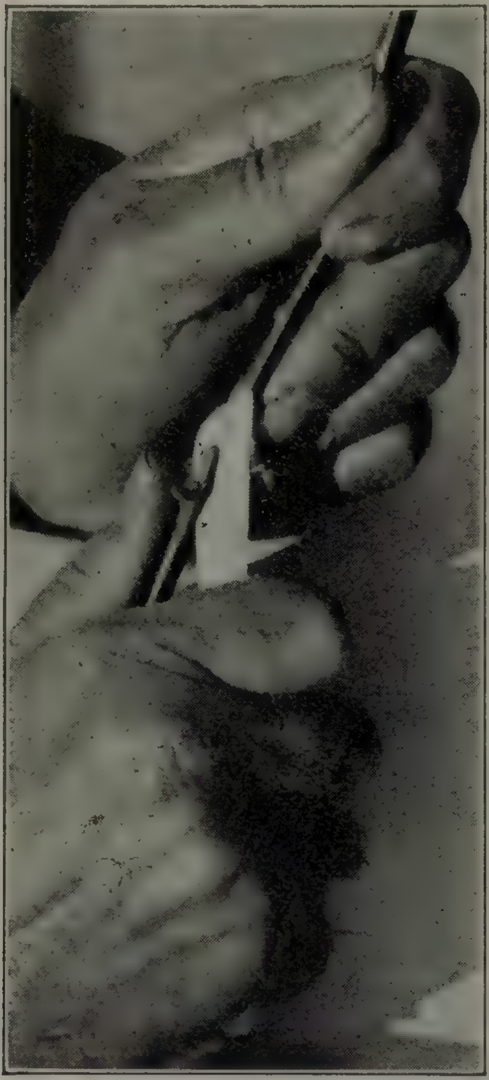

FIG. 32.—Cutting the bud

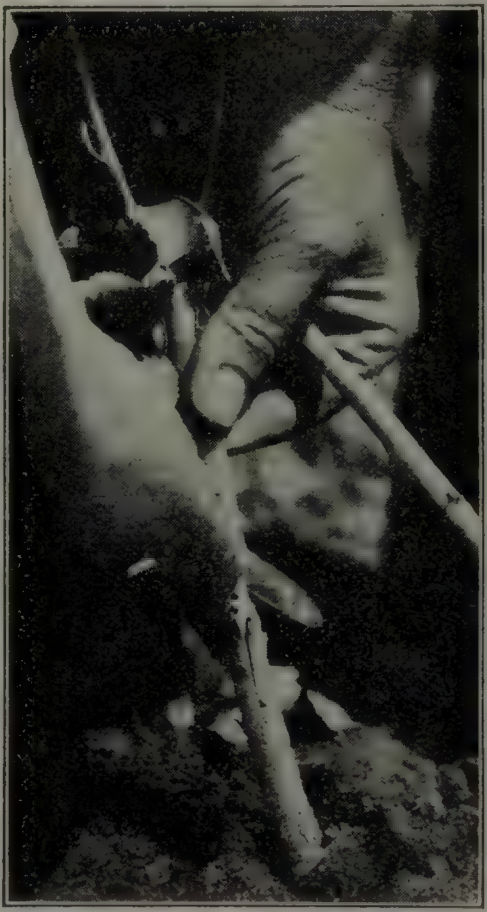

FIG. 33.—Starting the bud into the matrix while holding it on the knife blade

JUNE BUDDING

In the Southern and Pacific States where the long season permits, peach and other stone fruits often are budded as early as the stocks are large enough. The buds are then forced into quick growth with the object of obtaining trees large enough for orchard planting the same season they are budded, thereby gaining a year.

In some cases the wood from which the buds are to be taken is cut during the previous dormant season and kept in cold storage until the time for budding; in others the new growth from the varieties desired is depended upon to mature sufficiently to supply the buds.

This budding is done in May or June. Part of the stock top is either cut off or broken over at the time of budding, which treatment tends to induce the bud to start into growth rather than remain dormant all summer. Later, as growth from the bud starts, the stock is headed back still more, and when the shoot is several inches long the stock is cut off at the bud. Sometimes the stock is cut away entirely as soon as the bud has started instead of shortening it gradually, but such severe treatment has a weakening effect on the growth.

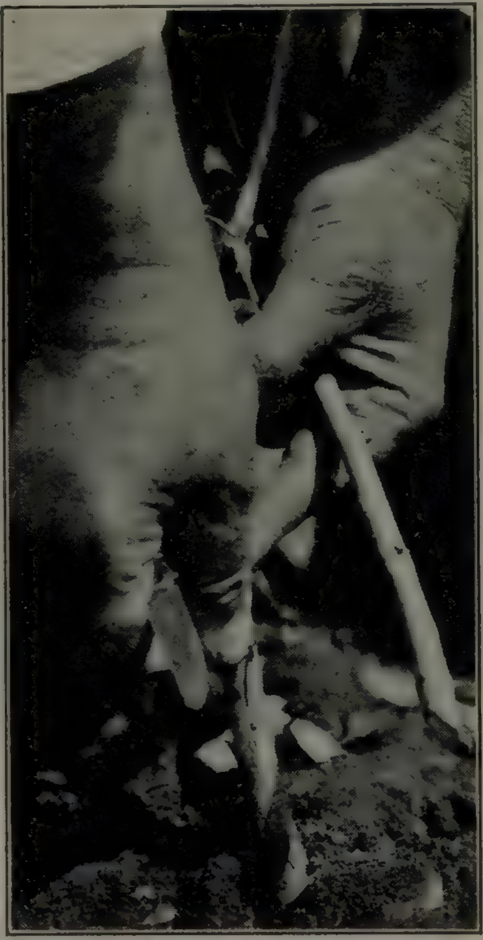

FIG. 34.—Pushing the bud down into place with the thumb

DOUBLE-WORKED TREES

Trees with trunks or intermediate portions differing from the roots or the tops by reason of having been twice grafted or budded are known as double-worked trees. The variety which is to form the trunk is grafted or budded and grown for one or two seasons in the ordinary manner, when it is again grafted or budded at the desired height with the variety which is to form the fruit-bearing top. Sometimes the intermediate is allowed to develop scaffold branches which are worked to the desired variety 1 foot or more from the main stem.

The object of double-working is to produce trees having trunks hardier, more resistant to diseases, or more vigorous than the varieties themselves. Examples where double-working is an advantageous practice are numerous. In the Pacific States the loss from pear blight on susceptible varieties such as Bartlett and Anjou is being greatly reduced by the use of a variety such as Old Home, known to be resistant, to form the trunk and framework branches. In the event the blight strikes the tops, it can spread only as far as the union with the resistant scaffold branches, and these can be worked later to form new bearing tops. Grimes Golden and other varieties of the apple subject to collar rot are made resistant by the use of some other variety such as Northern Spy or Delicious to form the lower part of the trunk. Weak-growing sorts such as Red Canada (*Steele's Red*) and Tompkins King are improved by top-working them on a variety that makes straight, vigorous trunks.

PROPAGATION OF SPECIFIC KINDS OF ORNAMENTAL TREES AND SHRUBS

In the following notes, brief reference is made to the methods most generally used for propagating certain kinds of plants about which questions are frequently asked. However, as conditions vary so widely, no one method of propagating a given plant may be said to be the best in all cases. The facilities available, the season of the year when the work may be fitted in with other operations, the condition of the mother plants, the number of new plants desired, and other factors all have a bearing on the choice of the most appropriate method.

Abelia (Abelia).—Cuttings of half-ripe wood in summer, or, in the South, by hardwood cuttings in the open.

Apple (Malus).—Ornamental species and varieties usually by whip grafting or by budding on ordinary apple seedlings.

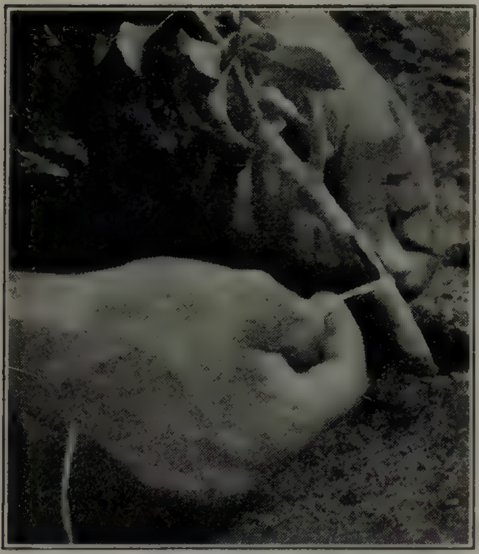

FIG. 35.—Starting the bandage by lapping the raffia over the lower end of the cut

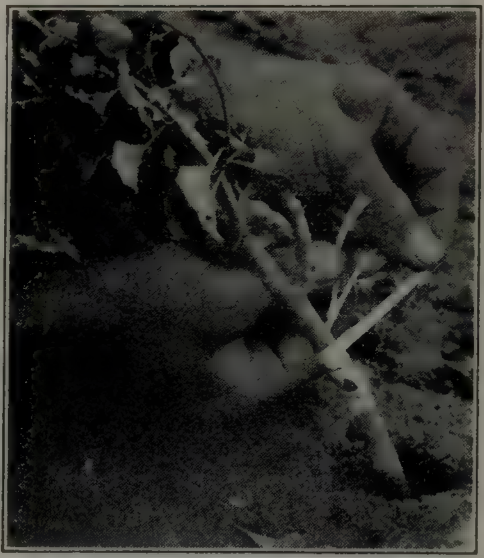

FIG. 36.—Completing the bandage by lapping the end under the last course, then drawing it tight

Arbor vitae (Thuja).—Seed kept dry and planted in spring. Varieties by cuttings under glass in summer or fall.

Ash (Fraxinus).—Seed, which should be stratified as soon as procured.

Azalea (Azalea).—The deciduous outdoor species by seed as described for rhododendrons. The Indian azaleas by cuttings of immature wood under glass and by grafting. All forms of azaleas can be layered.

Bald cypress (Taxodium).—Seed, planted in spring, which usually germinates poorly, hence should be sown thickly.

Barberry (Berberis).—Seed freed from pulp and planted in fall, or stratified over winter, is the readiest means for the species. Cuttings of nearly ripe wood in fall under glass and immature wood in summer are used successfully, but most varieties are rather slow to strike roots. Also by root grafting and by layering.

Beech (Fagus).—Seed stratified and kept in a cool place for spring planting or else planted as soon as procured. Purple beech usually is grafted on seedlings of European beech. Seedlings of purple beech have more or less purple color.

Birch (Betula).—Seed, which should be planted in fall or as soon as it ripens. Varieties are budded in the open ground or grafted on seedlings established in pots. White birch, *Betula alba*, is often used as a stock for cut-leaf weeping birch. Varieties are propagated also by layers.

Bittersweet (Celastrus).—Usually by seed freed from the outer coats and planted in fall or stratified over winter. Also by layers, root cuttings, and suckers.

Bluebeard (Caryopteris).—Cuttings of immature wood root easily. Also by seed planted as soon as ripe in fall under glass.

Boxwood (Buxus).—Cuttings of half-ripe wood in summer, or ripe wood in fall or winter under glass. Layers easily. Also by seed, but it is slow to germinate, and the seedlings develop very slowly.

Butterfly bush (Buddleia).—Immature cuttings in summer.

Catalpa (Catalpa).—Seed kept dry and planted after the ground warms in spring. *Catalpa bungei* as used for ornamental planting is budded or grafted several feet high on stems of *C. speciosa*, the hardy western catalpa. For the straight tall stems to form the trunk, 1-year seedlings are grown in rich soil one season, then cut back to the ground. The following spring the strongest shoot arising from the stump is saved and all other growth kept off. By late summer this shoot should be tall enough to permit top-working at the height desired. The union may be made by budding in September. It is advisable to use two or three buds on different sides of the stem to assist in the formation of a symmetrical head. The union also may be made in early spring by whip or cleft grafting. Grafted unions should be waxed.

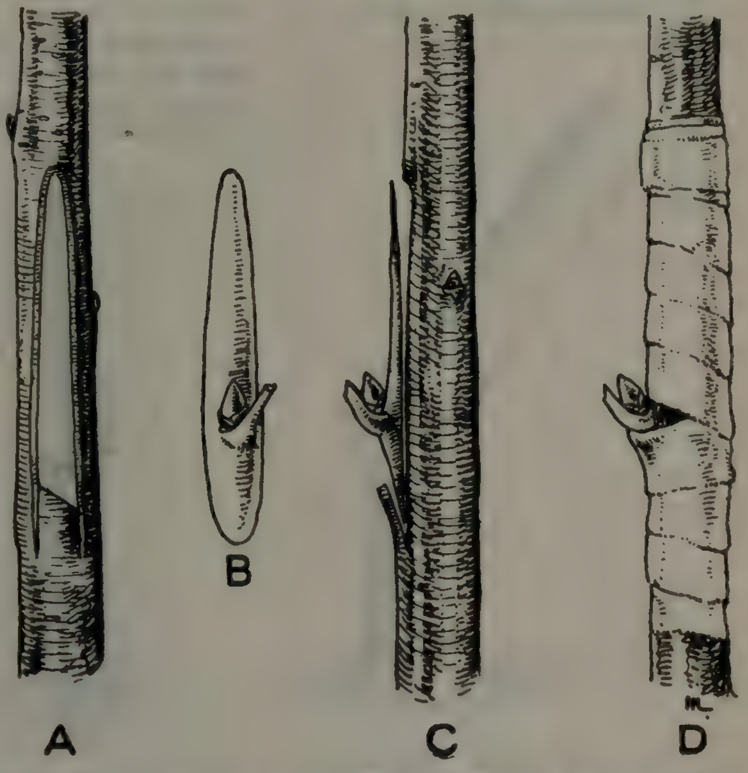

FIG. 37.—A simple and useful form of plate bud. A, Stock prepared by paring off a piece of bark, exposing the wood; B, bud cut similar to that for ordinary shield budding; C, bud in place; D, completed operation. Bud wrapped with waxed muslin

Cedar (the true cedar; Cedrus.—Seed kept dry and planted in spring after the soil becomes warm. Varieties by cuttings in summer or fall under glass or veneer grafted in winter on seedlings.

Chaste tree (Vitex).—Usually by seed planted in spring.

Cherry, Japanese flowering (Prunus).—Budded or grafted on seedling stocks. Mazzard is the stock most frequently used at present, though evidence indicates that the trees on this stock are short-lived in many situations. Grafts planted with the union several inches below ground level will often strike roots within a year or two from the scion above the union. Own-rooted trees obtained by this means are safer for general planting than those budded on mazzard. *Prunus serrulata*, *P. sachalinensis*, *P. pendula*, and probably other oriental cherries are regarded as better stocks than mazzard. Seed of these species is imported from Japan.

Cork tree (Phellodendron).—Seed planted in fall or stratified over winter.

Cotoneaster (Cotoneaster).—Seed stratified as soon as harvested. Often the seed lies dormant the first season. Also by mound layers. Some evergreen forms by cutting under glass.

Cranberry bush (Viburnum).—Seed stratified as soon as ripe and planted in fall or spring. Usually seed does not germinate until the second spring. Layers commonly root in one season. Also by immature cuttings under glass.

Crape myrtle (Lagerstroemia).—Seed kept dry and planted after the soil warms in spring. Cuttings of immature wood and hardwood cuttings root easily.

Cryptomeria (Cryptomeria).—Seed kept dry and planted after the soil becomes warm in spring. Cuttings in summer or fall under glass will root though slowly.

Cypress (Cupressus and Chamaecyparis).—Seed planted in spring. Varieties by cuttings in summer or fall under glass.

Deutzia (Deutzia).—Immature cuttings under glass or hardwood cuttings root easily.

Dogwood (Cornus).—*Cornus alba* and its varieties by hardwood cuttings. Flowering dogwood, *C. florida*, white form from seed stratified or planted as soon as ripe. Pink and red flower varieties by budding or grafting on seedlings of *C. florida*.

Elm (Ulmus).—Seed sown as soon as ripe in spring germinates quickly. The seed loses its viability if kept dry for any length of time. The oriental elms such as *Ulmus pumila* also may be root grafted on American elm, *U. americana*, or increased by immature cuttings under glass or by root cuttings.

False indigo (Amorpha).—Seed planted at once or stratified. Immature cuttings under glass.

Fir (Abies).—Seed kept dry and planted in spring.

Firethorn (Pyracantha).—Seed freed from pulp and planted or stratified at once. Cuttings of nearly ripe wood in fall under glass or by hardwood cuttings in the open where conditions are especially favorable. Also by grafting on mountain ash or on hawthorn seedlings.

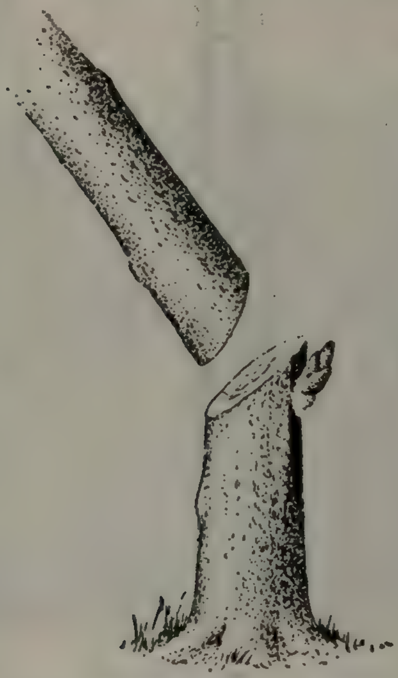

FIG. 38.—Stock top removed with a sloping cut just above the bud. Ordinarily this is done the following spring about the time growth starts

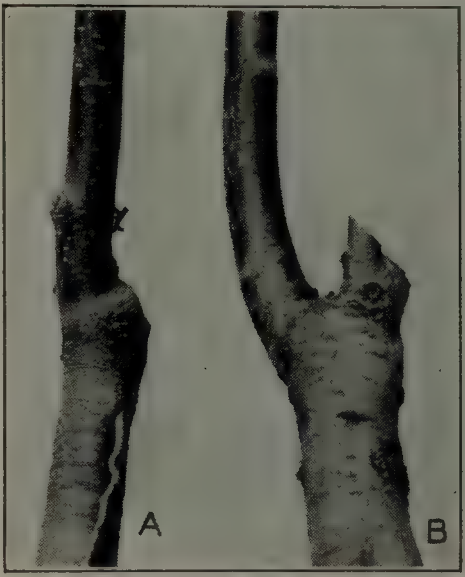

FIG. 39.—Bud unions of two cherry trees after one season's growth. Result of properly (A) and improperly (B) cut stock

Flowering quince (Cydonia).—Cuttings of nearly ripe wood in fall under glass or by seed, stratified or planted as soon as procured. Colors do not come true from seed. Also by layers, by division of the clumps, and by root cuttings.

Forsythia (Forsythia).—Either immature cuttings under glass or hardwood cuttings root easily.

Fringe tree (Chionanthus).—Seed kept stratified. Frequently the seed does not germinate until the second spring.

Gold-dust aucuba (Aucuba).—Cuttings of half-ripe wood in summer or nearly ripe wood in fall under glass.

Hackberry (Celtis).—Seed freed from pulp and kept stratified or planted in fall.

Hawthorn (Crataegus).—Seed freed from pulp and kept stratified. Usually does not germinate until the second spring. Varieties are budded or grafted on seedlings or layered.

Hemlock (Tsuga).—Seed kept dry and planted in spring.

Holly (Ilex).—Seed, which requires a long period for after-ripening, usually does not germinate until the second spring. Cuttings of immature wood root well if made in July and given mild bottom heat under glass. Also from mature cuttings in fall. The slender twigs stripped from the sides of branches with a heel make the best cuttings.

Honey locust (Gleditsia).—Seed either kept dry or stratified over winter. In spring place the seed in water heated nearly to the boiling point, set aside, and allow to soak for about 24 hours, then plant at once.

Honeysuckle (Lonicera).—Seed sown in fall or straified over winter. Cuttings of immature wood under glass and hardwood cuttings grow readily.

Hornbeam (Carpinus).—Seed planted in fall or stratified over winter.

Horse-chestnut (Aesculus).—Seed planted in fall.

Hydrangea (Hydrangea).—Cuttings in summer under glass and hardwood cuttings. Also by layers.

Juniper (Juniperus).—Seed should be stratified as soon as collected, after freeing it from pulp. Some species often delay germination until the second spring. Horticultural forms of *Juniperus chinensis* and *J. communis* are often propagated by cuttings under glass in summer or fall. Some forms of Juniperus root so slowly that veneer grafting on potted stocks is the readiest means. Red cedar is the stock most commonly used. The low-growing forms such as *J. sabina* can be increased by layers.

Kentucky coffee tree (Gymnogladus).—Seed treated as described for honey locust.

Larch (Larix).—Seed kept dry and planted in spring.

Lilac (Syringa).—Varieties are easily grafted or budded on Amur River or California privet. If the graft union is planted low so that the scion above the union stands in moist soil, the plants may become established within two or three years on scion roots. Although lilac seedlings make good unions with the varieties, they have the objectionable tendency to send up growth from below the union which may be overlooked, owing to the similarity of the foliage. Cuttings made in early summer at the time the wood begins to harden root well under glass with mild bottom heat.

Linden (Tilia).—Seed stratified as soon as procured and planted in fall or early spring.

Magnolia (Magnolia).—The different species usually by seed freed from pulp, then stratified, and planted in spring after the soil becomes warm. The seed is easily injured by drying. Heel cuttings in summer will root, though slowly. Grafted on *Magnolia kobus*, which is one of the best stocks, also on *M. acuminata* and *M. tripetala*, seedlings using the veneer graft on potted stocks. Also by layers put down in early spring and separated the following spring. The rooted layers should be planted in beds with protection, or potted and started in frames.

Maidenhair tree (Ginkgo).—Seed planted in fall or stratified over winter.

Maple (Acer).—Seed of species that ripen in spring should be planted as soon as ripe for immediate germination, as it soon loses its viability in storage. Seed of species that ripen in fall should be stratified or planted in autumn. Varieties by grafts on seedlings of species from which they sprung. The veneer or cleft graft is used under glass on stocks established in pots. Norway maple, *Acer platanoides*, is the stock for Schwedler maple. *A. palmatum* seedlings are used for Japanese maple varieties.

Mock orange (Philadelphus).—Usually by hardwood cuttings or by half-ripe cuttings in June or early July. Species may be reproduced by seed.

Mountain laurel (Kalmia).—Seed kept dry and planted under glass in early spring in peaty soil or leaf mold as for rhododendrons. Also by layers.

Mulberry (Morus).—Seed kept dry and planted in spring.

Nandina (Nandina).—Seed stratified as soon as procured. Often irregular in germination.

Oak (Quercus).—Seed planted in fall. Varieties are grafted on seedlings of closely related species.

Osmanthus (Osmanthus).—Cuttings of nearly ripe wood in fall under glass.

Papaw (Asimina).—Seed freed from pulp and stratified as soon as procured, then planted in fall or spring.

Pearlbush (Exochorda).—Seed planted in fall, preferably under glass. Cuttings from half-ripened wood in June or July under glass. Also by layers.

Persimmon (Diospyros).—The American species, *Diospyros virginiana*, and one of the oriental species, *D. lotus*, are readily grown from seed. Both are used as stocks for the Japanese fruiting varieties and the select forms of the native persimmon, but the American species is hardier and is more frequently used. To improve the scanty root systems of the seedlings it is advisable to grow them in beds one season, then transplant them to the open nursery for one season before grafting or budding them. The whip-graft union is successfully employed for both bench grafting and field grafting when the stocks are small.

For top-working larger trees the cleft or bark graft is used. When done in the open the union should be waxed.

Plane tree (Platanus).—Seed kept dry and planted in spring. Also by hardwood cuttings.

Plum (Prunus).—Species from seed, which should be freed from pulp and stratified as soon as ripe. Varieties usually field-budded. Myrobalan is one of the best stocks for the purple leaf plum, *Prunus pissardi*.

Privet (Ligustrum).—Seed stratified as soon as procured. The forms of privet commonly used for hedges are easily increased by hardwood cuttings in the open ground or by immature cuttings under glass. *Ligustrum lucidum* grows readily from seed, though cuttings root slowly. The variegated forms of *L. lucidum* and *L. japonicum* are grafted or budded on Amur or California privet.

Redbud (Cercis).—Seed stratified as soon as procured and planted in fall or spring.

Retinospora (Chamaecyparis and Thuja).—Cuttings in summer or fall under glass.

Rhododendron (Rhododendron).—Seed, layers, and grafts. The seed is kept dry until planted, usually in early spring in flats or pans of specially prepared soil under glass. The necessary acid soil can be provided by a mixture of one-half peat or partially decomposed oak leaves with one-fourth sand and one-fourth potting soil. The mixture should be dried and then rubbed through a screen. The prepared soil should be pressed down in the flats, leveled and watered, then allowed to stand overnight before sowing. The seed is very fine and usually mixed with chaff, hence should be sown thickly. It should be covered with a very light and uniform layer of sphagnum moss rubbed while dry through an ordinary fly-screen mesh. As an aid to preserve uniform moisture, it is desirable to cover the flats with panes of glass and stand them in shallow pans of water so that syringing or spraying will be unnecessary. Germination should take place within 30 or 40 days. The panes of glass may be kept in place until the seedlings begin to show their third leaves, when they are ready to be transplanted, spaced about 1 to 2 inches apart, into soil prepared as for the seed beds.

Layers are often employed for propagating the named varieties.

For grafting the named varieties, the principal stock is *Rhododendron ponticum* from seed. This stock, however, lacks the extreme hardiness required for the North. The plants are grown for two seasons to attain the proper size, then established in pots. Grafting is done usually in early spring under glass, with the use of scions from outdoors. The veneer graft is used to make the union.

Rose (Rosa).—Seed is the usual means of increasing the species. As soon as ripe the seed is separated from the hips and kept moist by stratifying it. Planting may be in either fall or spring. The seed may germinate quickly during the first warm days of spring, hence it must be planted early. The seed beds should be situated so that they can be watered if necessary, but the young seedlings ordinarily need no protection from direct sunlight.

The varieties of climbers and Polyantha types as well as some botanical species are often grown from hardwood cuttings in the open ground, especially in the South.

Hybrid teas are extensively propagated by immature cuttings in spring or summer under glass. Cuttings from plants grown in greenhouses usually root more easily than those from plants grown in the open. The stem is in condition for the cuttings about the time the flower opens. It is important that the plants from which cuttings are taken be healthy and free from leaf diseases. The cuttings may be made to include only one bud, called single-eye cuttings, but it is preferable to include two or three buds, removing the leaves except the one at the top bud.

Roses of nearly all types, but especially hybrid teas intended for outdoor planting, are also propagated in large quantities by budding in the open ground. Several stocks are in use. Manetti propagated by hardwood cuttings is one of the most widely used and best-known stocks. *Rosa multiflora japonica* from seed is one of the principal stocks in the Eastern States, and its use is increasing. *R. rugosa* from hardwood cuttings was formerly employed to a greater extent than at present. It is objectionable because of its persistence in sending out suckers from the roots. Gloire des Rosomanes (Ragged Robin) from hardwood cuttings is used for hybrid teas to a considerable extent in California. *R. odorata* from hardwood cuttings is coming into more extensive use, particularly in the Southern States, and also for greenhouse roses.

Russian olive (Elaeagnus).—Seed planted in fall or stratified. Often delays germination until the second spring. *Elaeagnus angustifolia*, also by hardwood cuttings.

Shadblow (Amelanchier).—Seed kept stratified or planted in fall or spring. Also by whip grafts and by layers.

Siberian pea tree (Caragana).—Seed planted in fall or kept stratified over winter.

Silverbell (Halesia).—Seed planted at once or stratified. Usually does not germinate until the second season.

Shrub althaea (Hibiscus syriacus).—Easily raised from seed planted in spring, but the seedlings do not come true to color. Varieties of both single-flowered and double-flowered forms by hardwood cuttings, also by grafting on seedlings. Variegated leaf varieties by half-ripe cuttings.

Snowbell (Styrax).—Seed planted as soon as procured or else stratified. Often fails to germinate the first season.

Spirea (Spirea).—Usually by hardwood cuttings or by immature cuttings in summer. Some species may be grown readily from seed planted as soon as ripe in summer.

Spruce (Picea).—Seed kept dry and planted in spring. Varieties are grafted under glass on seedlings established in pots. Norway spruce, *Picea excelsa*, or white spruce, *P. alba*, are used as stocks for the horticultural forms of Colorado blue spruce, *P. pungens*.

Sweet gum (Liquidambar).—Seed planted in fall or stratified for spring planting.

Sweet shrub (Calycanthus).—Seed planted in fall or stratified over winter. Mound layers.

Tamarix (Tamarix).—Usually by hardwood cuttings which root easily.

Tulip tree (Liriodendron).—Seed planted in fall or kept stratified over winter. Many of the seeds are likely to be imperfect, therefore thick sowing is advisable.

Weigela (Weigela).—Most varieties root easily from immature cuttings under glass or from hardwood cuttings.

Wisteria (Wisteria).—Seed grows readily. Also layers and by root cuttings in greenhouse with bottom heat. Cuttings of nearly-ripe wood in fall under glass will root, though slowly.

Yellowwood (Cladrastis).—Seed treated as described for honey locust.

Yew (Taxus).—Seed stratified as soon as procured and planted in fall. May delay germination until the second spring if allowed to dry. Cuttings in summer or fall under glass.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

April 4. 1929

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U. S. DEPARTMENT OF
AGRICULTURE
FARMERS' BULLETIN No. 1568

RABBIT PARASITES AND DISEASES

THE SUCCESSFUL RAISING of rabbits depends to a great extent on the ability to keep the animals free from parasites and bacterial diseases.

This applies particularly to those ailments which spread rapidly from one animal to another and take a heavy toll once they gain entrance to a rabbitry.

A study of the sanitary measures outlined in connection with rabbit feeding and the disposal of manure is also important.

Other factors which aid in keeping rabbits healthy are attention to ventilation and sanitary housing.

Washington, D. C. Issued December, 1928

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RABBIT PARASITES AND DISEASES

By BENJAMIN SCHWARTZ, *Senior Zoologist, Zoological Division*, and W. B. SHOOK, *Veterinary Inspector, Pathological Division, Bureau of Animal Industry*[1]

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PRINCIPAL CAUSES OF RABBIT AILMENTS

THE RABBIT INDUSTRY in the United States, though still in its infancy, has already assumed sufficient importance in certain parts of the country, especially on the Pacific coast, to warrant a serious consideration of the parasites and diseases of rabbits. In common with other animals under domestication, rabbits are subject to various pests, diseases, and ailments. The fact that rabbits are raised in close confinement from the time of their birth until they are sold or slaughtered renders them especially liable to parasitic diseases, many of which are acquired as a result of close contact with infested rabbits. A doe may harbor a few parasites that do not materially affect her health, but the transmission of the parasites to the young may give the latter a serious setback by stunting their growth, lowering their vitality, and, in the case of the more serious parasitic diseases, such as coccidiosis and ear mange, the young may die as the result of injury or from complete exhaustion of their vitality.

Before attempting to treat diseases or abnormal conditions, rabbit owners should make a thorough investigation of the cause. In the case of valuable animals and in the larger rabbitries the situation may necessitate consultation with an experienced veterinarian. This bulletin is published to furnish rabbit breeders with a practical knowledge of the more serious rabbit pests and diseases, together with methods of prevention and control. The discussion is divided into two main sections, dealing with parasites and bacterial diseases, respectively.

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[1] Acknowledgment is made of valuable suggestions and assistance from the Division of Fur Resources, Bureau of Biological Survey.

RABBIT PARASITES AND THEIR CONTROL

By Benjamin Schwartz

Among the parasitic diseases of rabbits those which deserve special attention are coccidiosis, ear mange or ear canker, skin mange, and stomach-worm diseases. The common results are weakness, emaciation, wasting, and death. Other parasitic affections, such as irritations caused by fleas, lice, and intestinal worms of various sorts, while not commonly producing very marked symptoms in infested animals, may gradually render them weak and unthrifty, making them more susceptible to other diseases as a result of their lowered vitality.

Treatment of certain rabbit diseases, except in the case of valuable show animals, should not be undertaken by breeders, as a rule, when but a few animals are affected. The sacrifice of one animal or a few animals affected with skin mange, coccidiosis, or parasitic worms is a simpler and often a safer procedure than a tedious course of treatment, with the danger of spreading disease to unaffected animals, especially in view of the fact that for some parasitic infestations of rabbits no effective treatments are known at the present time.

The treatment of animals for infestations with external and internal parasites or for other diseases is the business of the veterinarian, and when disease is present among rabbits breeders should seek his professional advice. The drugs used for treating external and internal parasites are in many cases highly poisonous substances, and questions of dosage, frequency of treatment, and whether a given animal should be treated at all are best solved by a veterinarian whose professional training, experience, and personal skill render him competent to handle such problems.

The prevention and control of disease is, however, the business of the breeder, and so far as concerns parasitic diseases of rabbits, control and prevention are often more practical than treatment. Prevention and control measures are usually matters of sanitation, in the broad sense of the word, and in the case of parasitic disease such measures must be based on a knowledge of the habits and life histories of the parasites involved and on their mode of transmission from one animal to another.

In dealing with parasitic diseases of rabbits, breeders should bear in mind that many of these diseases are spread from one animal to another either through close contact, as in the case of ear mange, skin mange, and infestations with lice, fleas, and other external parasites, or through the use of infested areas, especially in connection with the droppings, as in the case of coccidiosis and the diseases caused by certain worms that live in the digestive tract, since parasite cysts and eggs pass in the droppings. Prevention of mange and various skin parasites consists primarily in isolating and treating the affected animals or else killing them, followed by deep burial of the carcass or by cremation, and then thoroughly disinfecting their quarters and the adjoining quarters of other animals. Prevention of internal parasites, such as coccidia and worms, consists partly in thorough and frequent cleaning of hutches, since the infectious stage of the organisms causing these diseases develops in the droppings. The droppings should not be used to manure ground on which rabbit feed is grown, but should be destroyed by burning or should be plowed under on areas remote from where the feed is grown, as otherwise these disease organisms, many of which are long-lived and very resistant, will be introduced into the hutches with the feed.

EXTERNAL PARASITES AND PARASITIC SKIN DISEASES

External parasites live on the skin or else in or under the skin in burrows that open to the external surface. These parasites include (1) insects such as fleas, lice, and bots and (2) mites, which are small arthropods closely related to insects. The parasites that cause ear mange and skin mange in rabbits are mites.

MANGE

Rabbits are subject to four varieties of mange, namely, two forms of ear mange, commonly known to rabbit breeders as ear canker, which may be produced by two different types of parasitic mites, and two forms of general body mange or skin mange which may also be produced by two types of mites. The ear mange mites live among the scales and crusts which they produce as a result of pricking the skin superficially, whereas the mites producing general body mange or skin mange burrow into the skin; the latter are, therefore, more difficult to reach with medicinal applications than the former.

Mites reproduce by means of eggs which are deposited by the female. The eggs may be found in or under the scabs or in the burrows of the skin, and their detection in skin scrapings is sufficient to warrant a diagnosis of mange. The eggs hatch and the larvae have the same shape as the adults and are distinguished by the fact that they are smaller and have only six legs, whereas the adults are larger and have eight legs.

EAR MANGE

Cause.—The most common cause of ear mange in rabbits is a mite[2] (fig. 1) that is very closely related to mites that occur on horses, cattle, and other animals, the largest specimens of which are slightly more than one-fiftieth of an inch long. The mites are oval in shape, and the legs are visible outside the margin of the body when viewed from above. The disease produced by these mites is known as psoroptic mange. The other form of ear mange in rabbits, known as chorioptic mange, is produced by another species of mite[3] which is closely related to forms occurring on various domestic animals. This mite is somewhat smaller in size than the previous species, has very long legs that are visible outside the margin of the body when viewed from above, is oval in shape, and, so far as concerns habits and life history, resembles in most respects the organism that produces psoroptic mange. The symptoms of chorioptic mange are similar to those of psoroptic mange, but the disease is usually less serious.

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[2] *Psoroptes communis cuniculi.*

[3] *Chorioptes cuniculi.*

Symptoms.—In rabbits ear mange is generally confined to the ears (fig. 2), but the resulting inflammation may spread to the coverings of the brain. In exceptional cases the organisms of psoroptic mange have been found on the face, neck, and legs. The mites produce intense irritation and itching and a catarrhal condition of the external auditory canal, the discharge being brownish in color and having a distinct odor. The inside of the ear becomes caked with the discharge, and as a result of bacterial infection ulceration of the ear may be produced. The parasites often penetrate into the middle ear and sometimes even into the inner ear, in which cases they produce serious nervous disturbances. Shaking the head is a common symptom of ear mange. Owing to the irritation produced by the parasites, affected rabbits usually flap their ears and try to scratch inside their ears with their hind feet. In case the parasites penetrate the middle and inner ear, the head may be held in an oblique position. In a severe condition of this sort the twisting of the head has been found to be so pronounced that the lower jaw is uppermost. The disease is very contagious and generally runs a long course, sometimes for several months. Despite the fact that mature animals affected with ear mange usually eat well, they lose flesh. In advanced, untreated cases of ear mange young rabbits may become greatly emaciated and lose their appetites and may die in convulsions. In exceptionally severe cases the inflammation may extend to the

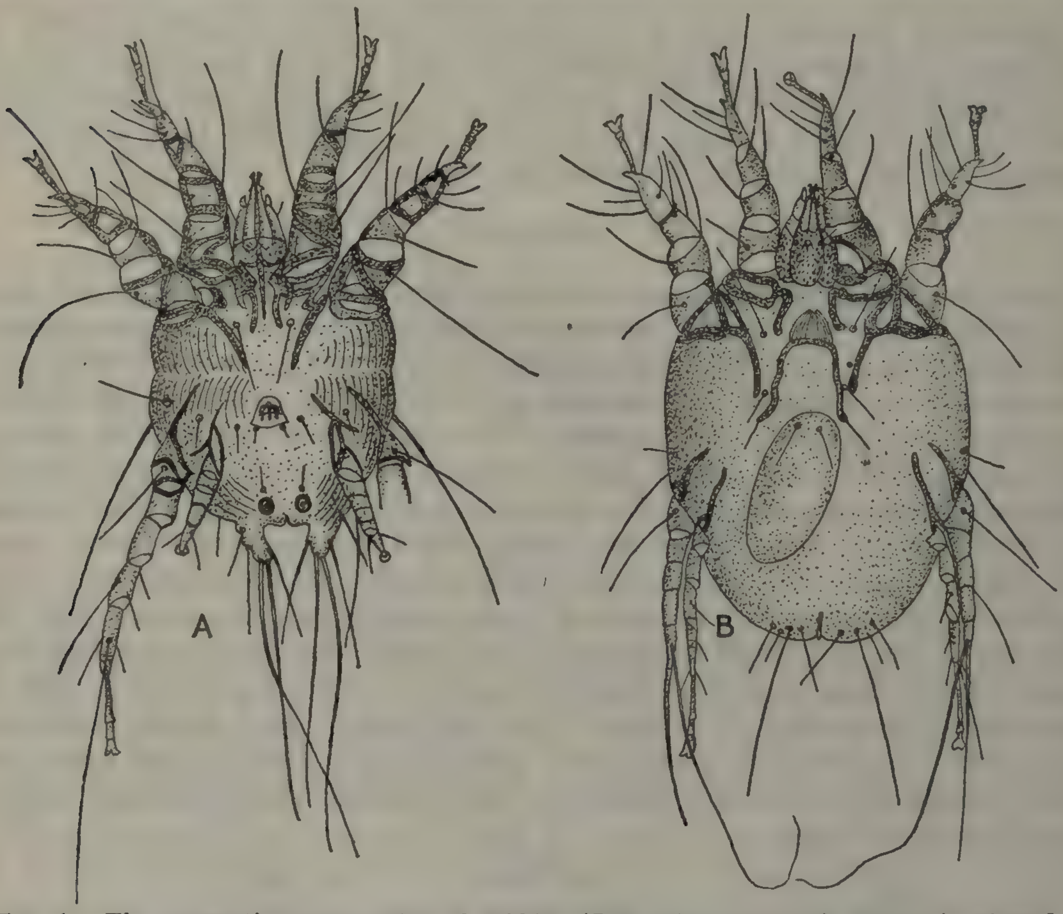

FIG. 1.—The psoroptic mange mite of rabbits (*Psoroptes communis cuniculi*) viewed from underside. (From Canestrini, 1894.) Enlarged. A, Male; B, female

coverings of the brain, and when this complication arises the animals die in a very short time. Old animals show a greater resistance to this disease than young ones.

Treatment.—Treatment for ear mange is relatively simple. The ear may be cleansed thoroughly with hydrogen peroxide, and all loose caked discharge and scab carefully removed. If one of the following treatments is applied, the oil used will soften the scab, which can then be easily removed. The affected parts are treated with an oil mixture, containing 20 parts of olive oil and 1 part of carbolic acid or cresol. Several treatments with this mixture may be necessary to effect a cure. After each treatment remove whatever scab material becomes loose. A method which is said to give invariably good results consists in dropping into the ear, every two or three days, 7 or 8 drops of a mixture of a bland oil, petroleum benzene, and kerosene. (All these ingredients are not absolutely necessary and the proportion used of each may also vary.) After several treatments the dropping of this mixture into the ear may be reduced to two applications a week until the trouble disappears.

The following treatment has been used successfully by the Bureau of Biological Survey in curing ear mange in fur-bearing animals, including rabbits. Prepare a mixture of 1 part iodoform, 10 parts ether, and 25 parts olive oil, petroleum, or cottonseed oil. Saturate a piece of cotton with this mixture and apply with the aid of a stick to the affected parts, the solution being allowed to run into the ear. A second application is given from 7 to 10 days after the first treatment.

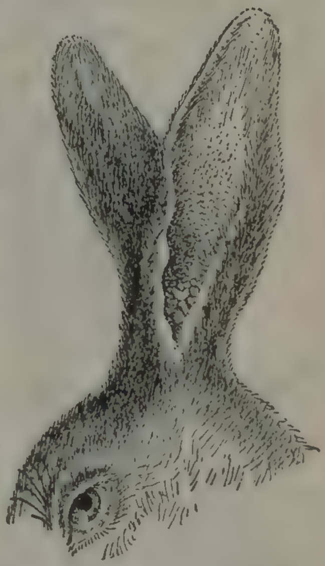

FIG. 2.—Rabbit's ear, showing mangy crusts. (From Moussu)

Other treatments known to be effective in ear mange in dogs may be tried, and the following preparations are recommended as worthy of trial: (1) 1 per cent solution of carbolic acid or creosote in glycerin; or (2) 5 per cent carbolic acid in olive oil or castor oil. Any one of these preparations may be applied with a cotton swab or by flooding the ear, and the treatment repeated until the animal is cured. Hutches in which rabbits affected with ear mange have been kept should have all litter and straw removed from them and should be thoroughly cleaned with a hot insecticidal solution of adequate strength in order to destroy any mites that may have survived in cracks and crevices. For this purpose coal-tar-creosote dips are useful. Unless this precautionary measure is taken the disease may reappear after treatment has been stopped.

SKIN MANGE

Cause.—Skin mange in rabbits may be produced by two different species of mites, one species[4] (fig. 3) producing a form known as sarcoptic mange and the other species[5] (fig. 4) producing a form known as notoedric mange. These two species of mites are closely related to forms occurring on various domestic animals. Sarcoptic and notoedric mange in rabbits are closely related diseases, producing

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[4] *Sarcoptes scabiei cuniculi.*

[5] *Notoedres minor cuniculi.*

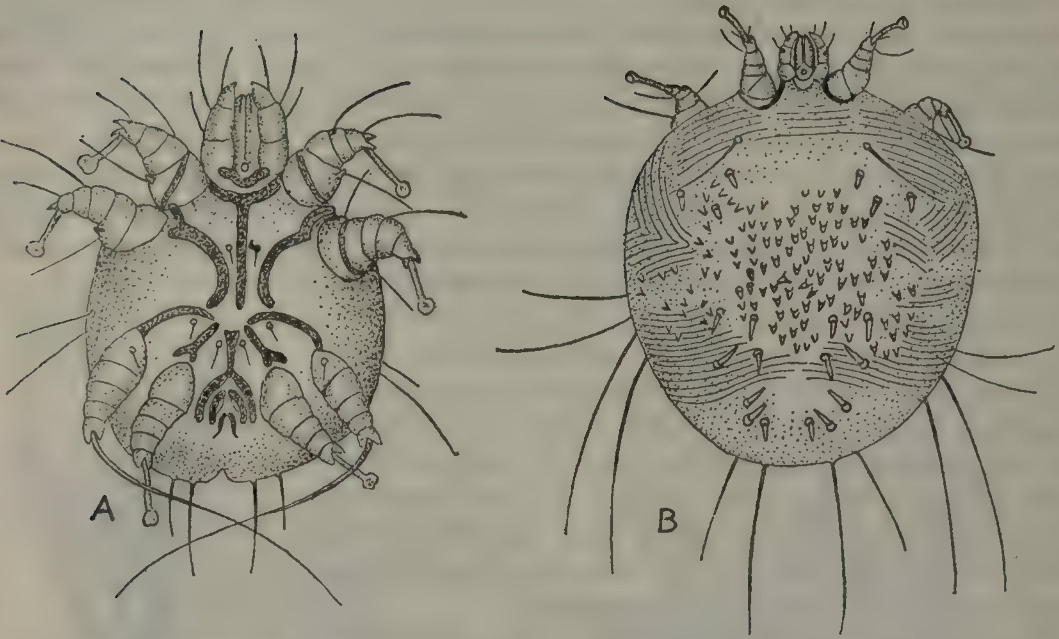

FIG. 3.—The sarcoptic mange mite of rabbits (*Sarcoptes scabiei cuniculi*). (From Canestrini, 1894.) Enlarged. A, Male, viewed from underside; B, female, viewed from above

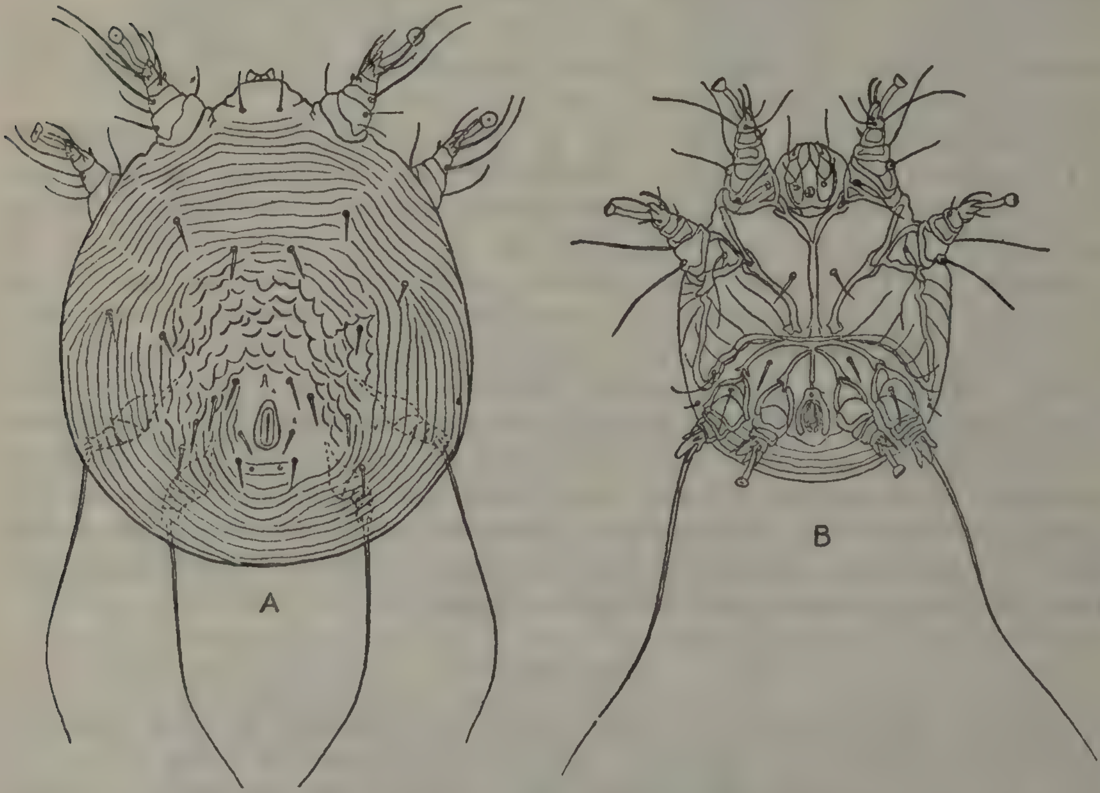

FIG. 4.—The notoedric mange mite of rabbits (*Notoedres minor cuniculi*). (From Hirst, 1922.) Enlarged. A, Male, viewed from above; B, female, viewed from underside

practically the same type of lesions. Sometimes the body of a rabbit may be affected with a combination of sarcoptic and psoroptic mange, the latter spreading from the ears to other parts of the body. The mites that produce skin mange are very small, being less than one-fiftieth of an inch long. They burrow deep in the skin, the female mites depositing their eggs in the burrows, where the young develop. In view of the location of these mites superficial skin scrapings often fail to reveal their presence. Rabbits suspected of harboring these mites should be scraped with the dull edge of a knife until blood is drawn and the scrapings should be examined by a competent zoologist or veterinarian for the presence of the parasites. It is very important to diagnose sarcoptic and notoedric mange early in order to prevent the diseases from spreading, as treatment is tedious and difficult.

Symptoms.—The presence of mites in the skin leads to serious alterations of the tissue due to the burrowing habit of these parasites. As the mites burrow, a serous exudate is formed, and it is the dried-up exudate that produces the characteristic scab. The skin irritation produced by the mites in various animals gives rise to constant itching, the animals scratching and rubbing the affected parts and thus producing open sores which may become infected. These are the outstanding symptoms and the ones which should lead the breeder to suspect the presence of mange. In sarcoptic mange of the rabbit the lesions occur on the tip of the nose, which may be transformed into a kind of proboscis, also on the lips, chin, forehead, ears, and legs, and may then spread to other parts of the body. The fur falls off, revealing grayish or yellowish crusts which stick closely to the skin. Sarcoptic mange in rabbits is a very contagious disease, and if not checked it will spread rapidly and kill the affected animals in the course of several weeks. In the last stages of the disease the animals are unable to eat, and they may die as a result of severe emaciation and complete exhaustion. Notoedric mange in rabbits first appears on the nose, then reaches the lips, the forehead, the face, especially round the eyes, and even the ears. It spreads to below the lower jaw and the extremities of the legs and produces skin itching and skin alterations similar to those observed in sarcoptic mange. (Fig. 5.)

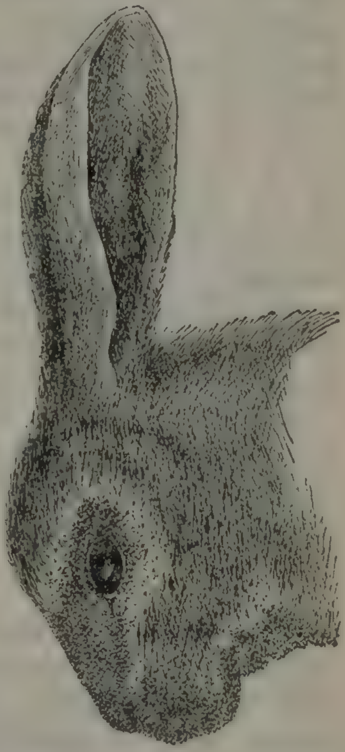

FIG. 5.—Rabbit's face affected with mange. (From Moussu)

Treatment.—Unless very valuable show animals are involved it is not advisable to undertake treatment for skin mange in rabbits. As soon as the disease is definitely diagnosed, the affected animals should be killed, and the carcasses should be buried deep or, preferably, cremated. The hutches occupied by infected animals should be thoroughly disinfected with hot, strong, coal-tar disinfectants, and all litter in the hutches should be burned. The animals in adjoining hutches should be isolated and kept under observation for several weeks, and the hutches occupied by them should also be thoroughly disinfected.

When it is considered desirable to undertake treatment, hygenic conditions, such as good feed and fresh air, are great aids. The hair over the diseased area, and preferably over the entire body, should be clipped, and the exposed crusts should be softened by being rubbed with green soap and a little warm water, which should be left on for an hour or two and then washed off with warm water. Much washing and bathing should be avoided. Rubbing in cod-liver oil in order to soften the scabs has also been recommended. Sulphur ointment, consisting of 1 part of sulphur to 3 to 4 parts of lard, or other preparations to be mentioned later, should be thoroughly rubbed into the affected parts every four or five days until a complete cure is effected. Inasmuch as less is known about the treatment of mange in rabbits than in some other animals, the following remedies known to be effective against mange in other animals are recommended as worthy of trial in rabbitries, the course of treatment being similar to the sulphur-ointment treatment: 1 part each of oil of tar and green soap in 1 to 5 parts of alcohol; or 1 part each by volume of oil of tar and crude petroleum oil and 6 parts of liquid petroleum; or flowers of sulphur 2 parts, oil of tar 1 part, potassium carbonate 1 part, and lard 8 parts; or flowers of sulphur 150 grams, potassium carbonate 8 grams, lard 60 grams; or flowers of sulphur 1 part, tincture of iodine 1 part, oil of tar 8 parts, and olive oil 8 parts.

After handling a mangy rabbit it is advisable for the person who administered the treatment to rub his own hands with the ointment to prevent becoming infected, as some forms of mange on animals may produce a slight infection in man.

WRY NECK

The condition known as wry neck is sometimes related to ear canker and is characterized by the rabbit's holding its head to one side, the symptoms gradually growing worse until the animal, no longer able to maintain its equilibrium, rolls over. In severe cases the rabbit is said to be unable to stand up and may die as a result of inability to eat.

Cause.—In addition to being associated with serious cases of ear mange, inflammation of the inner ear, and other things, wry neck or limber neck, as the condition is commonly called, is also said to be caused by a mite[6] (fig. 6), which occurs accidentally in the ears of rabbits. These mites occur normally in rabbit houses and buildings and swarm in hay, straw, fodder, in some grains, dried fruits, and in many other food substances. On getting into the ear of a rabbit the mites are apparently able to maintain themselves and to set up the diseased condition described above.

Treatment.—Treatments similar to those recommended in connection with ear canker should be used. Systematic dressing of the ears with a weak liniment of carbolic acid, turpentine, and tincture of opium in glycerin has been recommended as effective. If this disease occurs in a rabbitry, measures should be taken to examine the supplies of hay and other feed for mites of this species or to procure supplies known to be safe.

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[6] *Glyciphagus domesticus.*

LICE

Louse infestation may occur in badly managed rabbitries and is especially common on badly nourished and weak individuals.

Cause.—The rabbit louse[7] (fig. 7) is a bloodsucker and produces anemia and emaciation in cases of heavy infestation. The eggs or so-called nits are fixed solidly to the hairs by means of a gluey substance secreted by the louse. The young leave the eggs through an opening at one end of the eggshell. They have the general shape of the adults, and become adults gradually after several molts. Lice remain on their host throughout their life, being incapable of remaining alive for any length of time elsewhere.

Symptoms.—Lice produce great irritation of the skin as a result of their bites, causing the affected animal to rub, scratch, and bite itself in order to obtain relief. This constitutes a great drain on the animal's energy, its fur becomes ragged and covered with nits, and the skin becomes inflamed, showing reddened patches which are frequently aggravated by the animal's scratching itself.

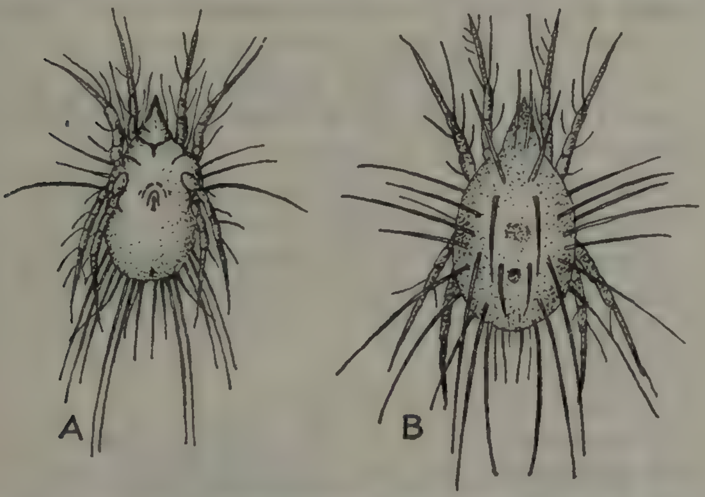

FIG. 6.—Mite (*Glyciphagus domesticus*) causing wry neck in rabbits. (From Pillers, 1920.) Enlarged. A, Male, viewed from underside; B, female, viewed from above

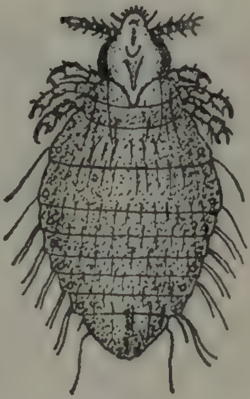

FIG. 7.—The rabbit louse (*Haemodipsus ventricosus*). (From Railliet, 1895.) Enlarged

Treatment.—In order to give a rabbit immediate relief the following treatment known to be effective in lousy dogs and other lousy animals may be used: The hair should be dusted with fresh pyrethrum powder, which should be allowed to remain for about a half hour, and then be brushed out with the dead and stupefied lice on to a piece of paper which should be burned. This treatment, which should be applied next to the skin or throughout the hair, may be repeated several times. More effective measures for the destruction of lice which have been found successful in treating dogs for lice consist in rubbing in oils, such as cottonseed oil, olive oil, or various vegetable oils used in cooking, allowing the oil to act for an hour or so, and then washing it off with warm water and soap or, preferably, removing it with bran. As a rule this treatment will kill both lice and eggs. If it does not do so, the treatment should be carried out twice, with an interval of about 10 days between, to destroy any lice that may have hatched out from the eggs after the first treatment.

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[7] *Haemodipsus ventricosus.*

FLEAS

Cause.—Three species of fleas are known to attack hutch rabbits in Europe. In the United States fleas on domestic rabbits are apparently rare, so far as present knowledge goes, an exception being the sticktight flea. One of the species[8] (fig. 8) of fleas known from rabbits is the true rabbit flea, the other species being the dog flea,[9] the cat flea,[10] the human flea,[11] and the sticktight flea.[12] * * * The last-mentioned flea is normally a parasite of poultry and is sometimes of considerable importance as a parasite of domestic rabbits in the Southern and especially the Southwestern States. The eggs of the flea develop in dirt and trash in the hutches and give rise to elongated larvae after a few days' incubation. The larva moves about by crawling and feeds on animal and vegetable débris. After a few days the larva spins a cocoon, gets rid of its old skin, and finally emerges as an adult flea. The adult fleas feed exclusively on the blood of the host.

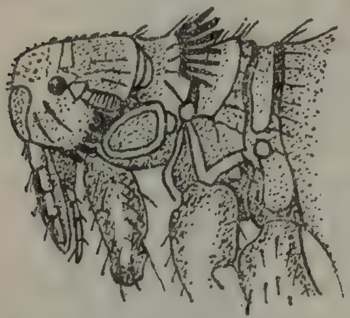

FIG. 8.—Anterior portion of the rabbit flea (*Spilopsyllus cuniculi*). (From Railliet, 1895.) Enlarged

Symptoms.—Fleas are known to attack especially the young, weak, and confined animals. They produce great irritation by their bites, causing intense itching and loss of sleep, and act as a drain on nervous energy.

Treatment.—Effective treatment against fleas should include not only the destruction of the adult flea but also simultaneously the cleansing of the premises and the destruction of the eggs and larvae. The animals should be dusted with pyrethrum powder, with powdered naphthalene, or powdered Derris root, which should be used as was recommended in connection with treatment for lice with pyrethrum, or treated with one of the bland oils recommended for destroying lice. The living quarters should be well scalded with boiling water or sprayed with a good grade of coal-tar-creosote dip containing between 10 and 16 per cent of tar acids to destroy the eggs, larvae, and pupae. As a preventive measure against fleas on rabbits, dogs, cats, and poultry infested with fleas should not be allowed to have free access to the area occupied by rabbit hutches.

CHIGGERS

In well-managed rabbitries chigger infestation is probably rare. The possibility of the occurrence of chigger infestation, however, should be considered and prompt measures taken to relieve infested animals, as suffering from this condition is usually intense when many chiggers are present. Chiggers may be introduced into rabbit hutches by feeding grass or lawn clippings from infested areas.

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[8] *Spilopsyllus cuniculi.*

[9] *Ctenocephalus canis.*

[10] *Ctenocephalus felis.*

[11] *Pulex irritans.*

[12] *Echidnophaga gallinacea.*

Cause.—The common American chigger[13] and related species are known to attack wild rabbits and doubtless will attack domestic rabbits. The parasites attach to the skin, engorge themselves with blood, and ultimately fall off.

Symptoms.—Chiggers produce intense itching as a result of their bites, thus causing the infected animals to rub and scratch themselves. The continuous rubbing and scratching produce skin sores which may become infected with bacteria.

Treatment.—Chigger infestation may be treated with repeated applications of alcohol. To alleviate itching, ammonia or sodium bicarbonate solution may be applied.

Chiggers live in underbrush and rank vegetation, and prevention consists in clearing the ground in and around rabbitries and keeping it free from rubbish which may afford shelter.

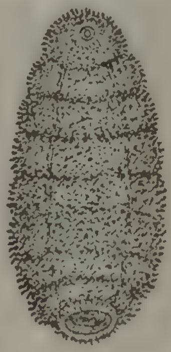

FIG. 9.—Rabbit bot (*Cuterebra* species). From Osborn, 1896)

WARBLES

Warbles or bots (fig 9) are common in wild rabbits and also occur occasionally in domestic rabbits. Warbles are the larvae of flies[14] (fig. 10) and occur between the skin and the flesh beneath, forming a lump, sometimes an inch long or even longer. Warbles in rabbits originate from eggs deposited by the adult flies on the rabbit's hair. The larvae are probably taken in by way of the mouth in some cases, but little is known about most species. In due time the warbles emerge from beneath the skin and the scar ultimately heals. If warbles are detected in rabbits they may be removed by slightly enlarging the opening in the skin with a sterilized knife and drawing them out with forceps. The cavity from which the grubs have been removed should be treated with a 1 per cent solution of cresol applied with a cotton swab.

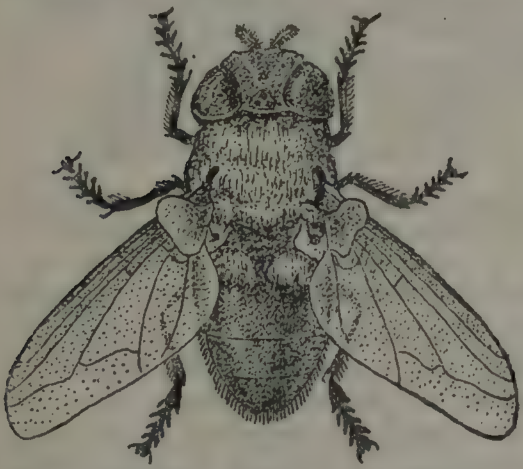

FIG. 10.—Adult rabbit bot fly (*Cuterebra cuniculi*). (From Osborn, 1896.) Enlarged

INTERNAL PARASITES

Internal parasites live in the tissues or cavities of the bodies of animals that serve as hosts for the parasites. Internal parasites of rabbits include very minute organisms known as Protozoa and such larger animals as tapeworms and roundworms. Protozoa are usually not visible to the naked eye and can be detected only with the aid of the microscope. Worms are usually visible to the naked eye, but in view of their usual location in the alimentary canal or in some other part of the body their presence in most cases can be detected only with the aid of the microscope. This is done by examining the droppings for the eggs produced by the female worms and expelled from the body with the droppings; these eggs are microscopic in size.

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[13] *Trombicula irritans.*

[14] *Cuterebra cuniculi* and related species.

PROTOZOA

Protozoa are minute forms of animal life, the individual consisting of but a single cell. Although a number of species of Protozoa are known to occur in rabbits, the only forms known to be definitely injurious to them are coccidia and certain flagellates. A protozoan blood parasite [15] from rabbits is known, and what may be this species has been found in Canada. Some zoologists regard it as harmless, but others consider it capable of causing profound weakness, emaciation, and even death. Pending further study, it is not given special consideration here.

COCCIDIOSIS

Coccidiosis is one of the most important and serious diseases of rabbits. It is of very common occurrence in wild and in domestic rabbits, one of the greatest drawbacks to the study of this disease being the difficulty of finding rabbits that are entirely free from it. All rabbits that harbor the organism of coccidiosis do not show symptoms of the disease. Many rabbits, especially grown ones, are merely carriers of the organisms, and although they are but little, if at all, inconvenienced by the parasites that they harbor, they transmit the disease to their young through the droppings. In young animals coccidiosis is liable to produce a serious condition and may cause their death.

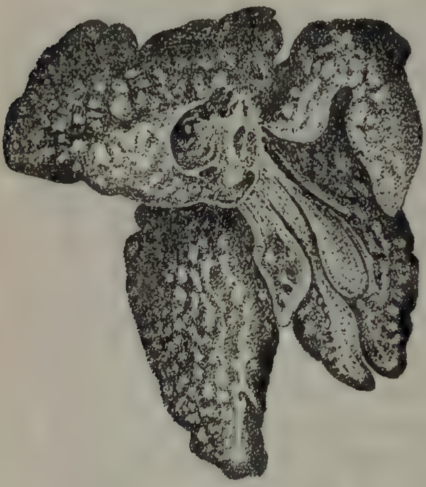

FIG. 11.—Rabbit's liver spotted with coccidia. (From Moussu)

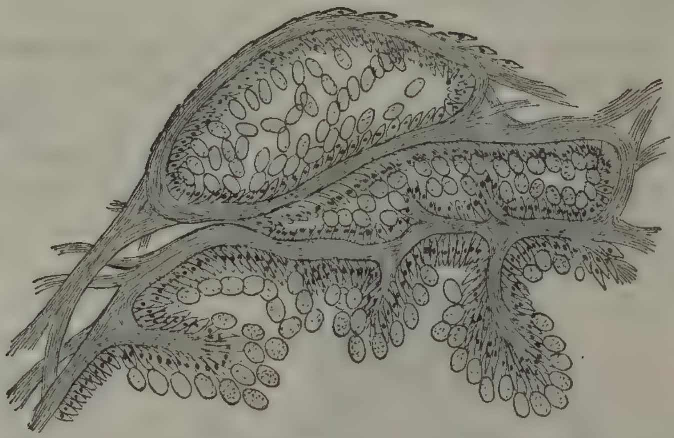

FIG. 12.—Section of rabbit's liver showing numerous coccidia. (From Railliet, 1895.) Enlarged

Cause.—The cause of coccidiosis is a very minute animal parasite visible only through the microscope. The parasites are known as coccidia and occur usually in the liver (figs. 11, 12, and 13) and in the cells lining the intestine; they have also been reported to occur in the nose and in other locations, and on rare occasions have been reported from the eye. Two species of these parasites are common in rabbits, one of them producing liver coccidiosis and the other producing intestinal coccidiosis. Coccidia gain entrance into rabbits with feed or drink that has become contaminated with the droppings of infected rabbits. They pass out of the body with the droppings, and in cases in which they affect the nose they are said to pass out with the nasal discharges.

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[15] *Trypanosoma cuniculi.*

LIVER COCCIDIOSIS

A condition due to the presence of coccidia[16] in the liver is generally known to rabbit breeders as spotted-liver disease. The whitish spots on the liver are masses of coccidia embedded in a creamy material. At a certain stage in their development, the parasites pass from the liver into the intestine through the bile ducts and are eliminated from the intestine with the droppings. The stage which occurs in the droppings is known as an oocyst, and is very resistant to ordinary drying, surviving this for several days, but will not resist actual dessiccation. It is also resistant to other usually injurious influences.

Symptoms.—Rabbits affected with liver coccidiosis may become weak, anemic, and pot-bellied, and may lose flesh, though some show no apparent symptoms. As the disease progresses affected rabbits may become more and more dull and listless, lose their appetite, and become greatly emaciated, the fur becoming rough, dull, and easily pulled out. This condition may last for two or three months and unless it clears up the symptoms become aggravated; the animals develop a staggering gait, a very pronounced anemia, and finally die in convulsions.

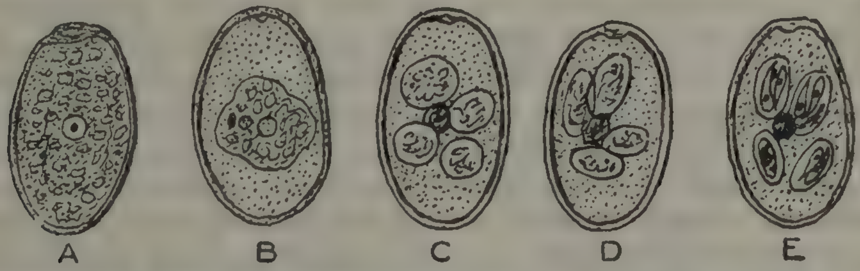

FIG. 13.—Stages in the development of the coccidial cyst (*Eimeria stiedae*). (From Hegner and Taliaferro, 1924.) Enlarged

INTESTINAL COCCIDIOSIS

Intestinal coccidiosis resembles liver coccidiosis, the two often existing together in the same animal. In intestinal coccidiosis the parasites[17] are entirely or largely confined to the mucous cells of the intestine. The cysts of the resistant stage are discharged with the droppings, as in liver coccidiosis, and serve to transmit the disease from rabbit to rabbit.

Symptoms.—Animals dead of intestinal coccidiosis show whitish spots of variable size on the mucous lining of the small intestine. These spots are caused by the accumulation of coccidia in the cells lining the intestine. The mucous membrane of the intestine is inflamed and sometimes ulcerated, and is covered with a discharge containing coccidia.

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[16] *Eimeria stiedae.*

[17] *Eimeria perforans.*

Intestinal coccidiosis produces practically the same effects upon the animals as liver coccidiosis. The rabbits lose their appetite, become emaciated, and suffer from diarrhea, the last-named symptom being especially characteristic of intestinal coccidiosis. Sometimes intestinal coccidiosis runs a long course, but in cases of very heavy infestation of the intestine death may occur in a few days after the onset of the disease. Intestinal coccidiosis is primarily a disease of young animals.

NASAL COCCIDIOSIS

Although this condition has been reported by several investigators, and is reported as occurring in the United States, it requires additional study. It is said to be caused by the presence of coccidia in the lining of the nasal canals and produces, according to published reports, an acute condition that has been designated as a malignant catarrh. Nasal coccidiosis should not be confused with snuffles, which is a bacterial disease. The two diseases may be differentiated by examining the nasal discharges with the microscope. If coccidia are involved the organisms may be detected with the microscope. The presence of coccidia in a nasal discharge might indicate merely a contamination of the discharge with coccidia from the droppings. If coccidia are absent, then the condition is usually due to bacteria.

Symptoms.—The symptoms of nasal coccidiosis, as described by different investigators, are similar to those of liver and intestinal coccidiosis and consist in lack of appetite and general dullness. In addition to those symptoms there is sneezing and much coughing, with a discharge from the nose, which is at first watery and later mucoid. The discharge from the nose glues the nostrils together and spreads to the fur of the breast and forelegs, to which it adheres. The temperature rises to 104° or 105° F. and breathing becomes difficult and is accompanied by considerable panting and pumping. Following great emaciation and weakness, convulsions set in, which terminate in death. The mucous lining of the nose is greatly inflamed and is covered with an orange-colored discharge which contains coccidia. Not only the mucous lining of the nose, but also the middle ear and pharynx may be affected by the coccidial organisms.

Coccidiosis of the nose usually occurs with intestinal and liver coccidiosis, but the method of infection of the nose with coccidia is not known at the present time.

Diagnosis.—Coccidiosis may be diagnosed from the symptoms, but the diagnosis should be confirmed by a microscopic examination of the feces, or of the nose discharges in the case of nasal coccidiosis. Coccidiosis should be suspected in rabbits that appear dull, listless, and unthrifty, and that suffer from diarrhea.

Prevention.—Preventive measures consist in keeping the hutches clean by removing the manure every day. Hutches with false bottoms consisting either of wooden slats or metal gratings that enable the pellets to drop through into a suitable receptacle will greatly aid in controlling coccidiosis, and have been found of great practical value in the control of this disease. Food and water containers should be placed above the bottom of the hutch to prevent their becoming contaminated with feces. However, irrespective of the type of hutch used, they should be thoroughly cleaned at least three times a week, as the coccidial cysts may develop under favorable conditions in two days and become infectious to other rabbits. Cleaning should be thorough, and hot water should be used if possible, as the cysts are ordinarily resistant to chemical disinfectants but are killed by heat. Hot water below the boiling point does not kill the cysts instantly, but at a temperature slightly above 131° F. the cysts are killed in about 30 minutes. Boiling water kills them rather quickly, and if live steam can be used it should be highly effective. The cysts are resistant to ordinary chemicals used for disinfection. A 3 per cent solution of cresol may kill the cysts in about 2 hours, but a longer period of 36 hours has been found necessary to insure their destruction.

Coccidiosis is frequently introduced into rabbitries with secondhand hutches. As a precautionary measure secondhand hutches should be scalded, scrubbed with boiling water and strong lye, rinsed with boiling water, and finally dried with a gasoline blowtorch or by exposure to sunlight for several days in warm weather. Care should be taken that the boiling water reaches all cracks and crevices of the hutches.

Coccidiosis may also be introduced with feed grown on ground that has been manured with rabbit feces and with green feed collected in ditches and other places that have become contaminated with feces of infected wild rabbits. Coccidia are more likely to be introduced into the rabbitry with green feed than with dry feed, such as alfalfa hay. The cysts do not live more than a few days after they have become dry. Green feed contaminated with coccidia is dangerous to rabbits and should under no circumstances be introduced into hutches.

Since adult rabbits harboring coccidia may show no symptoms of the disease but still serve as carriers and transmit the disease to young animals with which they come in contact, it is very important to isolate young rabbits from older ones. There is some danger, also, that coccidiosis may be introduced by bucks used for service. Because of this possibility and other reasons incident to good management, persons in charge of well-conducted rabbitries do not permit bucks to remain in breeding pens any longer than is necessary for mating.

In all cases sick and suspected animals should be isolated, and the carcasses of animals that died of coccidiosis should be destroyed by cremation. The feces of animals harboring coccidia should be destroyed, preferably by burning.

Since young animals are especially susceptible to parasites, including coccidiosis, and to the bad effects of parasitism, it is advisable to raise young rabbits away from older animals, other than the mothers, and away from the areas used by older animals, as far as possible. Young animals are special cases and require special care to tide them over the danger period of infancy and youth to the point where they have the hardiness and relative immunity to parasites of the older animals.

There is no treatment for coccidiosis in rabbits that has been tested on a sufficiently large number of animals to warrant its recommendation to rabbit owners. Quinine has been recommended as a remedy for coccidiosis in doses of one-tenth of a grain daily until the symptoms disappear. For internal administration quinine sulphate has been recommended, and for nasal coccidiosis quinine hydrochloride in solution is said to give good results. Until these drugs have been tested on a large series of animals nothing definite can be said as to their value in the treatment of coccidiosis.

INTESTINAL FLAGELLATES

A serious disease of rabbits has been described as being due to intestinal flagellates.[18] (Fig. 14.) These organisms occur in the small intestine and adhere firmly to the cells lining the intestine. The nature of the disease produced by these parasites is obscure. Affected animals die within a few hours or a few days after the appearance of the symptoms. Young rabbits may succumb within a few hours after symptoms appear, and old rabbits may live for several days. They refuse to eat, however, and have distended abdomens; post-mortem examination reveals putrefaction in the stomach. Until more is learned concerning this disease and its treatment, no recommendations can be made as to medicinal applications to be used. Prevention of the spread of these intestinal flagellates consists in following precautions similar to those recommended in connection with the control of coccidiosis, as the two diseases are spread in a similar manner.

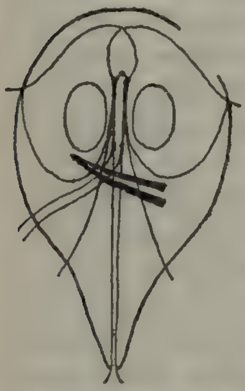

FIG. 14.—An intestinal flagellate (*Giardia duodenalis*) of rabbits. (From Hegner and Taliaferro, 1924.) Enlarged

WORMS

Worms occurring in rabbits are of three kinds, namely, tapeworms, flukes, and roundworms. Tapeworms occur in rabbits as adults in the intestine and as larval forms, known as bladder worms, in various locations in the body outside the alimentary canal. Flukes occur in rabbits in the small intestine and in the liver. Roundworms are slender, cylindrical worms, and those in domestic rabbits occur in the digestive tract, including the stomach, small intestine, large intestine, and cecum, and also in the lungs.

Worms in all animals act as a constant drain on the energy of the host, cause irritation of the lining of the alimentary canal, lungs, and other parts as a result of their bites or their adherence to the lining, and produce weakness, emaciation, and anemia. They commonly predispose affected animals to other diseases by lowering the vitality.

Worms are especially injurious to young animals and stunt their growth. Whenever unthriftiness, lack of appetite, diarrhea, anemia, and similar symptoms are present in rabbits, in the absence of coccidiosis, worms should be suspected.

While the extent of the injuries produced by worms in rabbits is not definitely known, inasmuch as the worm parasites of these animals have not been extensively studied, it may be concluded from the kinds of worm parasites known to occur in rabbits that they do some harm and in certain cases they probably do considerable harm.

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[18] *Giardia duodenalis.*

Worms in rabbits are in some cases closely related to worms occurring in cattle, sheep, and goats; and in these animals related worm infestations are often very serious.

TAPEWORMS

Larval tapeworms in domestic rabbits may occur in the liver and abdominal cavity, between the muscles, and under the skin, and are common, whereas the adult forms occur exclusively in the small intestine, and are not likely to be very common in hutch rabbits.

Intestinal tapeworms

Several species of tapeworms have been found in the intestines of rabbits, including domestic rabbits, the largest forms attaining a length of about 30 inches, but they are usually only half that length or less. A rabbit tapeworm (fig. 15) is flat, whitish, and ribbon-shaped, being made up of numerous segments, which are wider than they are long, and a head provided with four suckers, by means of which the worm is attached to the lining of the intestine. The oldest and ripest segments are those farthest from the head. Sooner or later the ripe segments, each of which contains numerous eggs, become detached from the rest of the tapeworm and pass out with the droppings, and this process is repeated throughout the life of the tapeworm. Beyond this point nothing is known concerning the development of these tapeworms.

As a general rule rabbits harboring one or a few tapeworms are not materially affected. When many tapeworms are present in the small intestine there are sometimes disturbances of digestion, more or less diarrhea, anemia, and emaciation. In cases of gross infestation death may occur as a result of extreme emaciation and severe anemia.

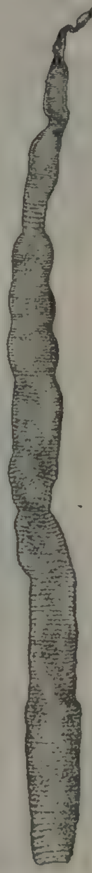

FIG. 15.—An intestinal rabbit tapeworm (*Cittotaenia ctenoides*). (From Stiles, 1896.) Half natural size

As a rule tapeworm infestation in hutch rabbits escapes detection unless the droppings are carefully examined for the presence of the whitish, ripe segment, which can be seen readily with the naked eye. If tapeworm segments are found, the feces of affected animals should be plowed under or destroyed by burning in order that spreading the disease be avoided, as the eggs in these segments constitute the starting point for fresh infections.

Very little is known regarding the treatment of rabbits for tapeworm infestation. The admixture of freshly ground areca nut with the feed has been recommended as a remedy for tapeworms in rabbits, but the value of this treatment is not well established. The minimum dose for a very young animal is one-fourth of a gram and the maximum dose for a fully grown animal is 1 gram, with proportionate doses for animals of intermediate sizes.

Bladder worms

The form that occurs in the liver and in the abdominal cavity[19] (fig. 16) is the single-headed bladder worm (cysticercus), which is much more common than that which occurs under the skin[20] (fig. 17), and which is the many-headed bladder worm (cœnurus).

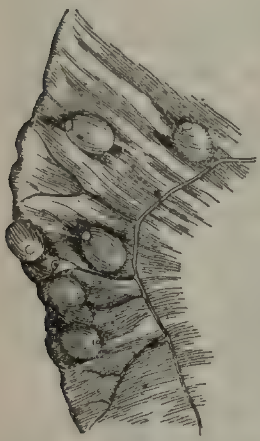

FIG. 16.—Fragment of mesentery of rabbit containing bladder worms (*Taenia pisiformis*). (From Railliet, 1895.) Approximately natural size

Rabbits acquire an infestation with bladder worms as a result of swallowing, in contaminated feed or water, the tapeworm eggs that are eliminated with the feces of dogs harboring the adult stage of these tapeworms. The young embryo present in each egg is released from the shell in the digestive tract of rabbits, bores through the wall of the digestive tract, and ultimately reaches its preferred location. Dogs in turn acquire an infestation with the adult tapeworms as a result of eating the bladder worms in the entrails, other viscera, and flesh of infected rabbits. The feces of dogs harboring the adult tapeworms are likely to contaminate the feed and water of rabbits, and for that reason it is necessary to exclude stray dogs from premises where rabbits and rabbit feed are kept and to make sure that the rabbits have feed and water known to be free from contamination from dogs' droppings. Dogs kept on premises where rabbits are raised should not be allowed to eat any part of a rabbit carcass that is not known to be free of bladder worms or else cooked; thorough cooking invariably kills the bladder worms present in any part of the carcass. Dogs kept on rabbit farms should be examined occasionally for tapeworm infestation by a competent veterinarian, whose advice should be strictly followed.[21]

Rabbits harboring many bladder worms in the abdominal cavity do not thrive, their growth being considerably arrested and sometimes permanently retarded. Young rabbits that harbor numerous bladder worms in the abdominal cavity become pot-bellied. Since all the bladder worms in the abdominal cavity pass through the liver, this organ may be seriously affected. Deaths from heavy infestation with bladder worms have resulted from excessive injury to the liver and from injury to the peritoneum.

The many-headed bladder worm occurs in the tissues between the muscles and under the skin of rabbits and may also occur in

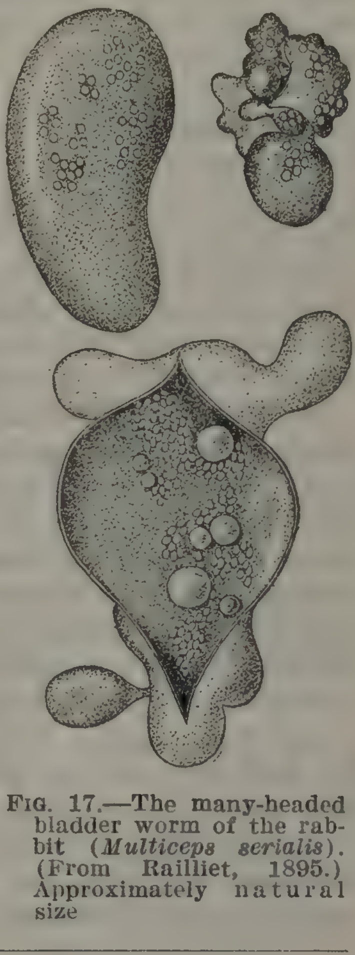

FIG. 17.—The many-headed bladder worm of the rabbit (*Multiceps serialis*). (From Railliet, 1895.) Approximately natural size

the heart muscle, lung, and other locations. The cysts may occur as single bladders or as branching forms, sometimes attaining considerable proportions, ranging in size from a minute cyst to the size of an apple. (Fig. 18.) The presence of these cysts may be readily detected when they are fully grown, and the superficial bladders may be felt through the skin with the fingers. They are usually noticeable when under the skin of the face, neck, legs, back, and shoulder. The many-headed bladder worm often impairs locomotion by virtue of its location and weight, which may cause interference with muscular movement. It may occur in the orbit, and in this location it may injure the eye. Heavy infestations kill the affected animals.

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[19] *Taenia pisiformis.*

[20] *Multiceps serialis.*

[21] HALL, M. C. PARASITES AND PARASITIC DISEASES OF DOGS. U. S. Dept. Agr. Circ. 338, 28 p., illus. 1925.

Treatment for bladder-worm infestation is usually out of the question, though the many-headed bladder worm may be removed by operation if it is superficial and if the value of the animal warrants the operation. As the disease is not transmitted from one rabbit directly to another, there is no danger of the spread of this disease except through infested dogs and by means of feed and water contaminated with the feces of such dogs.

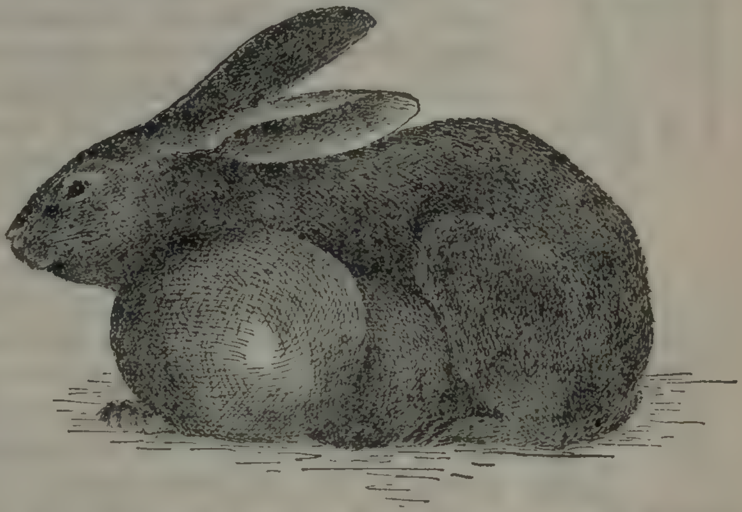

FIG. 18.—Rabbit, showing large cysts caused by subcutaneous bladder worms in the region of the shoulder. (From Moussu)

FLUKES

Several species of flukes have been reported from hares and rabbits, and of these, two deserve consideration. One form [22] is an intestinal parasite resembling a small seed and is about one twenty-fifth of an inch long and about half as wide. This parasite has been found in wild rabbits in the District of Columbia, Maryland, Virginia, New York, and Texas, and probably occurs in other parts of the country. The other form is the common liver fluke [23] of cattle and sheep and is flat and leaflike in shape, about 1 inch long and about half an inch wide, and occurs in the liver and bile ducts of the normal hosts and of other hosts, including wild and domestic rabbits.

Flukes have a complicated life cycle involving a snail intermediate host, in most instances. While the danger of fluke infestation in hutch rabbits is not very great, the possibility of introducing these parasites with hay or with green feed from wet and marshy places should be borne in mind. In certain sections of the South and on the Pacific coast and adjoining regions liver flukes are known to occur in cattle and sheep, and rabbit owners in those localities should take precautions not to introduce the infection into rabbitries with green feed or hay grown on or near places where fluke disease in cattle and sheep is known to exist.

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[22] *Hasstilesia tricolor.*

[23] *Fasciola hepatica.*

ROUNDWORMS

Stomach worms

The stomach worm of domestic rabbits in the United States[24] (fig. 19) is a very slender, cylindrical worm, about half an inch long, and more or less whitish in color. A very closely related form is known from these animals in Europe, but so far as as known the European stomach worm of rabbits[25] does not occur in the United States. The life history of the American stomach worm of rabbits has not been studied, but it is probably similar to that of the European form which has been investigated and is briefly as follows:

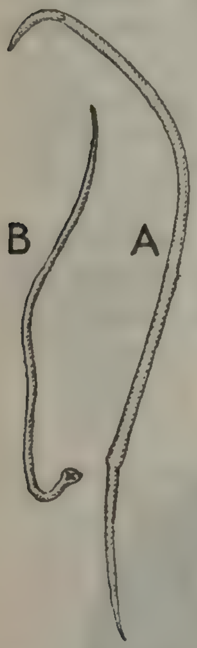

FIG. 19.—The American stomach worm (*Obeliscoides cuniculi*) of rabbits. A, Female; B, male. (From Chandler, 1924.) Enlarged

The eggs (fig. 20) produced by the female worms are elliptical in shape and are surrounded by a thin shell. On superficial examination they may be mistaken for coccidia. An egg is larger than a coccidial cyst, however, and has granular contents which segment, ultimately producing a larva, whereas the contents of a rabbit coccidial cyst ultimately develop into four sporocysts, each of which contains two sporozoites. (Fig. 13.) The eggs are eliminated with the droppings, and after a short period a small larva appears in each viable egg. The larva emerges from the egg and continues to develop, attaining the infective stage after a period of several days. Moisture and a certain degree of warmth are especially favorable to the development of the eggs and larvae of these worms. The infective larvae are swallowed by rabbits with feed and drink, and when they reach the stomach they presumably develop through the usual molts to maturity.

Several species of roundworms similar in size and appearance to the stomach worm are known to occur in the small intestine of rabbits (fig. 21), two species[26] appearing to be common in the United States. The life histories of the intestinal roundworms have not been studied, but it is probable that they are similar to that of the stomach worm.

Symptoms.— Roundworm infestation of the stomach and small intestine produces disturbances of various sorts that affect the health of rabbits, the degree of injury depending on the susceptibility of the rabbit and on the degree and nature of the infestation. Light infestations appear to produce little effect, but when the animals are heavily infested they may be emaciated, suffer from diarrhea, and often from anemia, and may even succumb to the

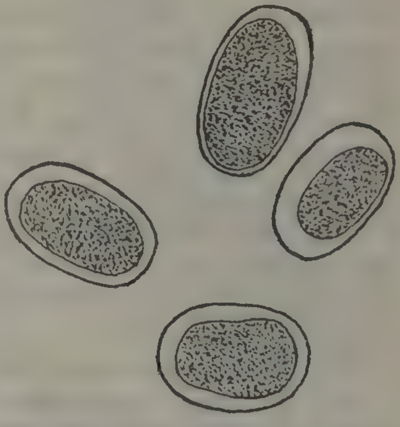

FIG. 20.—Eggs of the American stomach worm of rabbits. (Original.) Enlarged

disease. The stomach worm of American rabbits produces ulceration of the stomach wall. The worms adhere closely to the mucous lining of the stomach and may push their heads deep into the lining.

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[24] *Obeliscoides cuniculi.*
[25] *Graphidium strigosum.*
[26] *Trichostrongylus calcaratus* and *Nematodirus leporis.*

Roundworm infestation of the stomach and small intestine has been found in a severe form in Europe among rabbits kept on the ground. The animals were found to be extremely emaciated, weak, and unable to run away from dogs. In severe epizootics many animals died, and those that survived were of very little value.

Prevention.—In the absence of information as to treatment for stomach and intestinal roundworms in rabbits precautions should be taken to prevent the parasites from gaining a foothold in rabbitries. As the infective larvae are transmitted through the feces of infected animals, frequent cleaning of hutches constitutes a reasonable safeguard. All feed grown on ground that has been manured with rabbit feces should be avoided, as there is great danger of introducing in this way not only roundworm infestation but also coccidiosis. The droppings of animals suspected of harboring these parasites should be destroyed, and rabbits that appear weak, dull, unthrifty, and undersized should be isolated from healthy animals. Precautions taken to prevent coccidiosis also aid in controlling these roundworms.

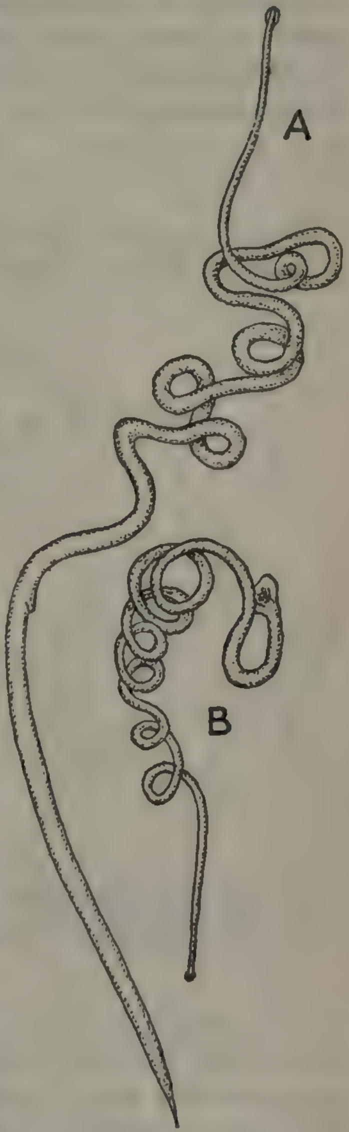

Fig. 21.—An intestinal roundworm (*Nematodirus leporis*) of rabbits. A, Female; B, male. (From Chandler, 1924.) Enlarged

Pinworms

Pinworms [27] (fig. 22) are whitish in color, the largest forms being about half an inch long. They are very common in both wild and domestic rabbits and occur in the cecum and large intestine. They frequently wander out of the body through the anal opening, and it is probable that they cause irritation in the anal region, as pinworms are known to cause this in other animals. The parasites spread from one animal to another by means of the eggs of the worm which occur in the droppings of the infested animals. Nothing is known at the present time regarding treatment of the pinworms in rabbits. The worms may be controlled to some extent by isolating infested animals and taking special precautions to destroy their droppings, preferably by burning or by plowing them under on areas remote from those on which rabbit feed is grown. Thorough cleaning of rabbit hutches at frequent intervals helps to control these parasites.

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[27] *Passalurus ambiguus.*

Whipworms

Rabbits harbor whipworms[28] (fig. 23) in the cecum. The largest specimens are more than an inch long and consist of a long, slender portion, which is commonly attached to the lining of the cecum, and a thicker portion, which is free in the lumen of this organ. Whipworms are said to feed on serum; and while the extent of their injury to rabbits is unknown, they are not to be regarded as harmless parasites. There is no known treatment for these parasites in rabbits. Prevention should be based on the same principles as the control of pinworms and of other worm parasites.

Lungworms

Two species of lungworms have been reported from domestic rabbits. One of these worms[29] is the sheep lungworm and is primarily a parasite of sheep and goats and only a rare parasite of rabbits, whereas another species of lungworm[30] is a parasite of wild rabbits and has also been found to occur occasionally in domestic rabbits. On the whole, lungworms do not appear to be common in domestic rabbits. Lungworms of rabbits are very slender, brownish red in color, and the largest specimens are less than an inch in length. They occur in the bronchi and in the deeper spaces of the lungs. The eggs of the sheep lungworm develop and hatch in the air spaces of the lungs, and the young worms pass from there to the bronchi and thence into the windpipe, from which they reach the mouth and are usually swallowed, passing out in the droppings. The young worms can live for some time in water and are capable of living for a long time under unfavorable conditions, including dryness. Lungworms in sheep and in other animals produce a bronchopneumonia which may terminate fatally. No effective treatment for lungworm infestation is known. Prevention consists in isolating sick animals from healthy ones and in thoroughly disinfecting the hutches in the way indicated in connection with coccidiosis.

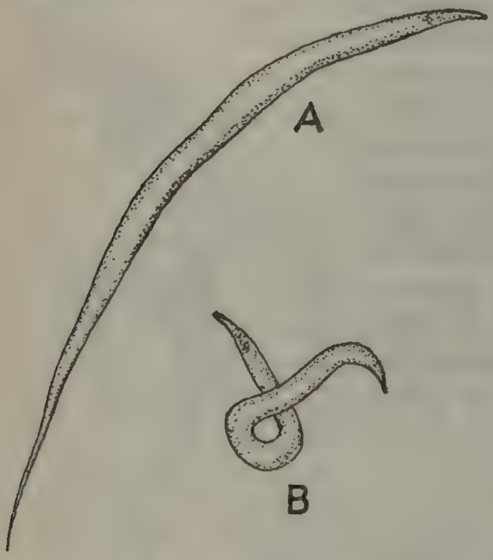

FIG. 22.—The pinworm of rabbits (*Passalurus ambiguus*). A, Female; B, male. (Original.) Enlarged eight times

SANITARY MEASURES TO CONTROL PARASITES

From the foregoing account of the parasites of rabbits and their method of spreading from one animal to another, it will be seen that if great care is given to general sanitation of rabbitries the chances of spreading parasitic diseases are greatly reduced. Hutches that are kept in a clean and dry condition do not favor the development of coccidia cysts and of worm eggs. Damp, ill-kept hutches, full of manure which is kept continually moist by admixture with urine, constitute a favorable place for the infection stages of coccidian and of other parasites, and these may retain their vitality for a long time. Hutches should therefore be of sanitary construction designed to allow the fecal pellets to drop through the bottom and the urine to drain. The feces and urine should drop into a tray which should be emptied frequently and then scrubbed and scalded with boiling water before being replaced. The contents of the tray should not be dumped near the rabbitry but should be removed to a place remote from the rabbitry and should be burned or plowed under. Under no circumstances should rabbit manure be placed on ground where rabbit feed is grown, and unless this precaution is scrupulously followed parasites will probably be prevalent in the rabbitry.

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[28] *Trichuris leporis.* [29] *Synthetocaulus rufescens.* [30] *Synthetocaulus commutatus.*

Dishes for water and feed should be scalded daily, as they are very likely to become contaminated with pellets, even though the hutches are of sanitary construction. All loose litter should be removed from the hutches daily and should be destroyed, preferably by being burned; and the hutches should be disinfected at intervals of two days, when coccidiosis is present, with boiling water or by washing with a strong coal-tar-creosote solution. The process of disinfection should be thorough, care being taken that the boiling water or chemical disinfectant penetrates all cracks and crevices of the hutches. Secondhand hutches should always be disinfected thoroughly before being used, as they are likely to be contaminated with coccidian cysts and with eggs and larvae of worms.

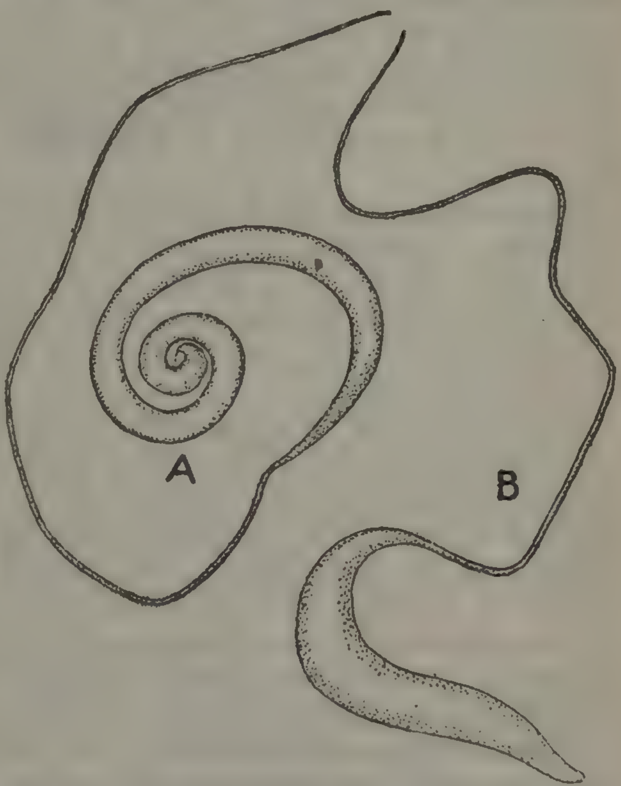

FIG. 23.—The whipworm of rabbits (*Trichuris leporis*). A, Female; B, male. (Original.) Enlarged

Only clean feed and water should be given to rabbits, and the feed and water should be placed in containers well above the floor of the hutches so as to prevent their becoming contaminated with the droppings. Good feed, fresh air, and plenty of light are important aids in combating diseases of various sorts, including parasitic diseases. All stray dogs should be excluded from rabbitries, and any dogs kept on premises near rabbitries should be free from tapeworms. Systematic examination and treatment for tapeworms of dogs kept on the premises are important preventive measures.

It is desirable that quarantine hutches be maintained at some distance from the rabbitry and that all sick animals and animals suspected of harboring parasites be kept in quarantine until known to be healthy, and that all new stock be kept in quarantine for at least two weeks. This precaution should also be followed, if possible, with reference to buck rabbits that may be introduced for service. Animals kept in quarantine should be closely watched for symptoms of disease, and a microscopic examination of the feces for worm eggs and coccidia should be made by a competent person. If coccidia are found, rabbits showing this infection should be entirely excluded from the rabbitry. The same procedure should be followed in cases of infestations with worms.

Whenever coccidiosis and other parasitic conditions are suspected of being present, it is advisable to employ a veterinarian. One or more rabbits showing symptoms of parasitism should be killed, and the alimentary canal should be slit open in order to determine whether worms or coccidia are present. The liver should be examined for white spots. Specimens of parasites or of diseased tissue should be forwarded to a competent zoologist or veterinarian for diagnosis.

Inasmuch as healthy adult rabbits are often carriers of coccidia and other parasites, it is best to separate young from adult rabbits as soon as possible. For the same reason young animals should be raised on clean areas not previously occupied by older animals. Flea-infested dogs, cats, and poultry should be kept away from areas occupied by rabbits.

Young animals of all sorts are especially susceptible to infestation with parasites and suffer more severely than older ones from the effects of parasitic infestation. It is therefore highly important to take all possible precautions to prevent young rabbits from becoming infested with parasites. The setback that they may receive early in life as a result of parasitism may seriously impair their growth and vitality and make them permanently weak and unthrifty.

Special precautions should be taken in cleaning and disinfecting the hutches in which pregnant does are placed, by removing all litter and thoroughly cleaning and scrubbing the hutches. The bedding that is placed in them should be free from possible contamination with rabbit or dog manure. Before the doe is placed in the kindling hutch, all litter adhering to the surface of the doe should be removed by hand and with a brush.

Only clean feed and pure water free from possible sources of contamination should be introduced into these hutches. With these precautions the opportunities for the young rabbits to acquire parasites will be considerably lessened. Care should be taken that no litter of any sort from hutches in which mature rabbits are kept is introduced into hutches containing young animals, and as far as possible kindling hutches should be isolated from other hutches.

These precautions will not only help to control parasitic diseases but may also help to control, to some extent, bacterial infections. If young rabbits are tided over the period of life during which they are most susceptible to diseases of various sorts, losses from disease later in life may be considerably diminished.

BACTERIAL AND OTHER DISEASES

By W. B. Shook

Once disease breaks out in a rabbitry, measures should be taken to limit its spread as quickly as possible. The medicinal treatment of rabbits sick from an infectious disease is usually an impracticable procedure, unless only a few are being raised and, indeed, even in these cases the value of such treatment is questionable.

Sick animals should be isolated, and in cases when the mortality is high such animals should be destroyed as soon as possible so as to remove all centers of infection quickly. The carcasses of all animals should be burned or buried. The hutches and all utensils used in feeding and watering should be thoroughly cleaned by scrubbing them with a hot soda solution and disinfected with 3 per cent compound cresol solution or 5 per cent carbolic acid or other suitable disinfectant. All bedding and litter should be burned.

To determine the nature of the infection causing an epizootic a post-mortem examination is usually necessary and in many cases should include an examination by a trained bacteriologist. When laboratory aid is required a sick rabbit or one recently dead should be furnished. As post-mortem changes in many cases obscure pathological conditions and render the specimen unsuitable for bacteriological study, it is essential that the carcass be in as fresh a condition as possible. The body of a rabbit that has just died should be selected, packed in ice or completely covered with powdered borax. A complete history of the epizootic, together with the method of feeding and housing should also be furnished. Most cities have commercial laboratories which perform bacteriological work for physicians and veterinarians, through whom arrangements may be made.

HEMORRHAGIC SEPTICEMIA

Hemorrhagic septicemia, or rabbit septicemia, is an acute infectious bacterial disease, caused by the *Pasteurella cuniculicida* (*Bacterium lepisepticum*). The disease may be contracted by the ingestion of food or water contaminated with the virulent organism, or by direct contact with infectious material. It has a high mortality when it gains entrance into a rabbitry. As a rule the disease runs a rapid course, the animals usually dying in 24 to 36 hours.

Symptoms.—There is a high temperature, lusterless coat, inappetence, and there may be a diarrhea. The animal is droopy and soon succumbs to the infection. In many rabbitries where snuffles is present, some of the animals may die of a general infection due to the hemorrhagic-septicemia germ.

Post-mortem.—Findings in the acute cases may show no marked changes as the animal dies of a septicemia. However, when lesions are found they consist of hemorrhagic areas in or on one or more of the various organs or on the linings of the body cavities, or in the alimentary canal. Pneumonic areas may also be found in the lungs.

Treatment.—Treatment of affected animals is of no avail. Sick animals should be isolated and properly destroyed. Hutches which have been contaminated by sick rabbits should be thoroughly cleaned and disinfected before being used by healthy stock. Carcasses of rabbits dead of the disease should be burned or buried.

Preventive treatment in the noninfected animals, by the administration of hemorrhagic-septicemia bacterin or aggressin is indicated, but this should be undertaken only by a veterinarian.

CONTAGIOUS NASAL CATARRH (SNUFFLES)

Contagious nasal catarrh, usually called snuffles, is a contagious disease, characterized by inflammatory disturbances of the mucous membrane of the nasal passages, windpipe, and lungs, and sinuses of the head.

Cause.—While there is still an element of doubt regarding the cause of the disease, there are at least two germs which are constantly found either singly or together in the nasal discharges and affected tissues. They are known as *Alcaligines bronchisepticus* (*Bacillus bronchisepticus*) and *Pasteurella cuniculicida* (*Bacterium lepisepticum*). These organisms have at times been found in the air passages of apparently normal rabbits, and it has been suggested that certain unfavorable conditions tending to lower the resistance of such animals enable the germs to assume a true disease-producing rôle with enhanced virulence.

Symptoms.—In its most common form the affection runs a chronic course manifesting itself in symptoms of persistent, white, tenacious, nasal discharge, frequently accompanied by crust formation on the nostrils. There is sneezing and apparent nasal obstruction, with a marked tendency for the animal to rub its nose with its paws, the fur of which soon becomes soiled and matted. As the disease progresses there is loss of appetite and considerable wasting away and weakness often leading to death. In many instances animals appear to become adapted to the chronic disease and survive with little loss of weight. In some cases there may be well-marked symptoms of nasal catarrh and loss of appetite and weight, which subside after a number of days, and the animals return to normal.

Later the same animals under conditions which lower their resistance may again develop symptoms of the disease. Several such attacks may occur during the course of a year. Occasionally the affection is acute, the animal dying after a few days' illness, manifested by symptoms of pleurisy or pneumonia. In some cases abscesses develop under the skin of the abdomen, the back, at the base of the ears, or on the legs. They may occur singly or in clusters and vary in size from that of a pea to that of an egg or larger. The contents of the abscess are usually yellowish-gray in color and of a dry, cheesy consistence.

Treatment.—Occasionally a mild transitory inflammation of the nasal mucous membrane with a slight discharge of mucus may be mistaken for snuffles. Such cases should be isolated in dry, well-lighted hutches, ventilated so as to prevent sudden changes of temperature, and held under observation until the true nature of the affection is determined. Once snuffles is definitely diagnosed, no medicinal treatment appears to be adequate. It has been found more profitable to destroy the animals as quickly as possible after the onset of symptoms and to burn or bury the carcasses than to attempt either isolation or treatment.

All new stock should be isolated in separate hutches for at least two weeks and precautions taken by means of disinfection to prevent infection being carried by the attendant, or else they should be cared for by a special attendant.

TULAREMIA

Tularemia is a specific, infectious, bacterial disease caused by *Pasteurella tularensis* (*Bacterium tularense*). While this disease has been reported only in wild rabbits, it has been proved experimentally that domesticated rabbits are also susceptible to the disease. Tularemia assumes importance from the fact that it can readily be transmitted to man, and while it has not been reported in domesticated stock, the proved susceptibility of such stock and the transmissibility of the disease to man warrant its discussion with other diseases of rabbits.

The disease is carried from infected rabbits to healthy stock by the wood tick (*Dermacentor andersoni*), the rabbit tick (*Haemaphysalis leporis palustris*), the deer fly (*Chrysops discalis*), and the rabbit louse (*Haemodipsus ventricosus*).

The disease is transmitted to man by the deer fly, the wood tick, or by the handling and dressing of infected rabbit carcasses.

Post-mortem.—An animal dead of the disease usually shows numerous necrotic spots in the liver and spleen, while besides these lesions, in laboratory animals infected by inoculation, the lymph glands, especially in certain parts of the body, as the abdomen and groin, are swollen and inflamed and sometimes contain pus.

As a safeguard to those handling wild rabbits during the hunting season or otherwise, it is very important to use rubber gloves when dressing rabbits. This is especially advised when the disease is known to exist in a particular locality.

Treatment.—Treatment of this disease is of no avail and should not be undertaken on account of the susceptibility of man to infection. Once the disease has been diagnosed, all sick animals should be destroyed and the entire carcasses burned or buried deeply. The hutches should be thoroughly cleaned and then disinfected with 3 per cent compound cresol solution or other suitable disinfectant.

Tularemia has been found to exist in small wild animals in Utah, Montana, Wyoming, New Mexico, North Carolina, Virginia, and other States.

NECROBACILLOSIS (SCHMORL'S DISEASE)

Necrobacillosis, also known as Schmorl's disease, may be defined as a bacillary necrosis, characterized by a progressive ulceration of the skin of various portions of the face or by abscess formation in different regions of the body. The causative organism, known as *Actinomyces necrophorus* (*Bacillus necrophorus*), is found widely distributed in nature and may enter the body through wounds produced by scratching, biting, or coarse food.

Symptoms.—The symptoms vary considerably, depending on the point of entry of the germ. The infection may at first cause a painful purplish swelling of the upper lip which gradually spreads until the skin of the whole face is involved. In other cases the infectious process may begin as a swelling of the lower lip and extend slowly under the jaw and throat to the region of the breast. There is a gradual death of the affected skin and underlying soft tissues with eventual sloughing. The surface of the wound thus exposed has a dirty, grayish-white appearance, is somewhat dry, and relatively free from pus. The deeper parts of the affected areas are hard and necrotic. While the disease is progressing in the region of the head, there may occur more or less severe ulcerations of the skin of the hind legs and around the vent. In still other instances there may be no involvement of the face, but the abscesses may occur on the thighs, flanks, undersurface of the body, or other regions. These abscesses form rather slowly and range from pea size to walnut size. The wall of the abscess is composed of thick, tough, fibrous tissue, and it contains a thick, creamy, and, at times, cheesy pus. The affected animals have great difficulty in moving the jaws and in consequence eat very little. They become weak and emaciated and, after a period of illness lasting from two to several weeks, succumb to the disease.

Post-mortem.—There may be found besides the external lesions rather marked swelling of the glands about the head, throat, and groin. Theer may be evidence of pneumonia and areas of consolidation in the lungs and an excess of cloudy fluid in the chest cavity and heart sac. Abscesses similar to those occurring under the skin may be found in the internal organs.

Treatment.—Treatment of the disease is largely surgical, but is usually not successful, except in the case of a few local abscesses, and even in such cases, unless the entire wall of the abscess is removed by carefully dissecting away from the healthy tissues, healing will not occur. Preventive measures are most important and consist in destroying the affected rabbits, burning all litter and soiled food material, cleaning and disinfecting the hutches, buildings, utensils, and feeding and watering receptacles. A complete change of food is often advisable.

PNEUMONIA

Pneumonia is a common disease of the rabbit and in the majority of cases is fatal, the animal dying in from two to four days.

The disease may be caused by direct exposure to drafts, sudden changes in temperature, and to damp and insanitary quarters. It accompanies certain infectious diseases.

Symptoms.—The animal is droopy, refuses food, the breathing is labored, there is a fever, the eyes may be watery, and there may be a mucous pussy discharge from the nose.

Post-mortem.—The lungs are the seat of the disease and may show numerous consolidated or liverlike areas. Both lungs may be wholly involved, or the lesions may be confined to portions of one or both lungs.

Treatment.—Since pneumonia in the majority of cases is fatal, treatment is usually of no avail. Insanitary conditions should be corrected if they are the cause, and suitable quarters prepared for the animals. As the disease is often infectious, the usual precautions of isolation and cleaning and disinfection should be taken.

STREPTOBACILLARY PSEUDOTUBERCULOSIS

As the name implies, this is an infectious disease resembling tuberculosis but caused by a specific germ known as *Corynebacterium* *rodentium* (*Streptobacillus pseudotuberculosis rodentium*). Outbreaks of the disease may occur in rabbits of any age, and the mortality is high.

Symptoms.—There is weakness, emaciation, difficulty in moving about, inappetence, and labored breathing, especially pronounced during an exertion. The affection runs a chronic course, usually terminating in death.

Post-mortem.—Examination reveals a rather marked degree of emaciation, numerous small, whitish, cheesy nodules scattered throughout both lungs, and similar nodules in the liver and spleen. The kidneys also are sometimes the seat of such nodular lesions. The intestinal tube, particularly the blind gut, is studded with nodules.

Treatment.—No treatment is recommended, but rather the prompt destruction of the affected animals, removal of healthy stock to uncontaminated quarters, and the thorough cleaning and disinfecting of the houses, utensils, and premises. On account of the similarity of the disease to true tuberculosis, coccidiosis, and certain parasitic affections, an early diagnosis is often difficult; therefore laboratory aid should be sought.

INDIGESTION

Indigestion in the rabbit is frequently due to injudicious or excessive feeding and especially to the exclusive feeding of succulent green stuffs. Abrupt changes in the ration may also be productive of digestive disturbance. Keeping rabbits in cold, damp, dark, or poorly ventilated hutches, or under otherwise insanitary conditions tends to render them more susceptible to digestive disorder.

Symptoms.—The symptoms are dullness, lack of appetite, restlessness, colic, and sometimes diarrhea. In the acute form of the disease there may be an excessive secretion of saliva, which drools from the mouth and wets the hair about the jaws.

Treatment.—Provide dry, comfortable quarters, withhold all food for 24 hours, then allow only water for another 24 hours. After that a diet of bread and sweet milk may be offered to the animal for several days. Hay, grains, and carrots may then be fed in moderate quantities. As a corrective give 5 to 10 drops of the aromatic syrup of rhubarb or 5 grains of bicarbonate of soda dissolved in a teaspoonful of warm water.

In case of diarrhea it is advisable to withhold all fresh green foods, allowing only well-cured hay and such digestible cereals as rolled oats or barley meal.

DIARRHEA (SCOURS)

Causes.—Besides being a symptom of certain infectious diseases and parasitic infestations, diarrhea of rabbits, especially young animals, is frequently brought about by sudden changes of weather, damp, insanitary hutches, excessive quantities of green foods, musty hay or grain, or any circumstance tending to lower the general vitality.

Symptoms.—The symptoms are loose, watery, offensive bowel movements, which cause extreme weakness and sometimes depression in the animal.

Treatment.—Provide a clean, dry hutch, well bedded with dry straw or sawdust.

Discontinue all green foods, substituting boiled rice and scalded milk. A powder consisting of 3 to 6 grains of bismuth subnitrate and 5 to 10 grains of bicarbonate of soda may be given in a teaspoonful of warm water twice daily.

When the symptoms of the disease have disappeared the animal should be restored by gradual degrees to a normal, balanced ration consisting of greens or succulent roots, in addition to suitable clean grains and well-cured hay.

CONSTIPATION

Causes.—Constipation is somewhat rare in rabbits, being confined principally to those that are overfed, or maintained on an exclusive ration of concentrated feeds, such as grains, with little or no green stuff. Sometimes hairs are swallowed with the food, and these form a ball in the intestine, obstructing the digestive tract. Sudden exposure to extreme cold may also bring about a suppression of the muscular activity of the bowels, causing constipation.

Symptoms.—The rabbit sits in a huddled position, dull and indifferent to food. The bowel movements, if any, consist of small, hard dung pellets, covered with mucus, and sometimes adhering one to another.

Treatment.—Correct the diet by feeding some succulent vegetable matter, such as cabbage, roots, or any of the green feeds relished by the animal.

Give the affected rabbit one-fourth to one-half teaspoonful of Epsom salt dissolved in water, or 1 to 2 teaspoonfuls of castor oil, according to the size of the animal.

SORE HOCKS

Cause.—The occurrence of sore hocks is not uncommon in domesticated rabbits, owing to close confinement under insanitary conditions. In poorly kept hutches, where the droppings accumulate and become saturated with urine, this ammonia-laden filth becomes intensely irritating to the hocks, rendering them tender, inflamed, swollen, and cracked. If this condition is neglected, the affected parts may become ulcerous, and infection may ensue.

Treatment.—Thoroughly cleanse the hutches and keep them clean. Wash the sore hocks of the affected rabbits, using warm water and soap, and then apply iodoform or a 1 per cent compound solution of cresol. The animals should be well bedded with dry leaves or straw until fully recovered. In case of the formation of an abscess, this should be opened, drained, and irrigated with hydrogen peroxide until thoroughly cleansed. Finally a weak tincture of iodine should be introduced into the cavity by means of a cotton swab.

Prevention.—When rabbits are kept on hard floors, their hocks should be examined at frequent intervals. At the first sign of bareness or tenderness, the soles should be anointed once each day with zinc-oxide ointment or carbolated petrolatum (1 per cent).

U. S. DEPARTMENT OF
AGRICULTURE
FARMERS' BULLETIN No. 1569

EARTHWORMS *as* PESTS *and* OTHERWISE

EARTHWORMS are both useful and injurious. They contribute to the enrichment of the soil by opening up the subsoil and improving the physical condition of the land, and they furnish the most widely used bait for fishing in inland waters.

They prove objectionable in lawns and golf courses, however, by their habit of building up mounds of earth at the entrance to their burrows, which break the smooth surface desired both for appearance in the lawn and for the needs of the game on the golf links.

In this bulletin instructions will be found for collecting fishworms and for keeping them and raising them in large numbers for sale; and, also, for those who are not interested in their useful side, this bulletin gives directions for exterminating them in lawns, golf greens, and flower beds.

Washington, D. C. Issued October, 1928

EARTHWORMS AS PESTS AND OTHERWISE

By W. R. WALTON, *Senior Entomologist, Division of Cereal and Forage Insects, Bureau of Entomology*

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GOOD AND BAD POINTS OF EARTHWORMS

EARTHWORMS are the most familiar inhabitants of the soil. Although present in almost all soils, they abound in heavy soils; and in the United States they are especially plentiful in old lawns and grasslands throughout the humid regions. The publication by Charles Darwin in 1882 of a treatise, The Formation of Vegetable Mould Through the Action of Earthworms,[1] resulted for a long time in the general view that they were entirely beneficial in so far as the welfare of man was concerned. During recent years, however, this opinion has undergone considerable modification owing to interference caused by earthworms in the maintenance of lawns and especially to their common occurrence on golf greens, where their castings form lumps or irregularities that interfere seriously with the play. The rapid popularization of the game of golf and the consequent recent multiplication of golf courses throughout the country have led to an ever increasing demand for information regarding methods of destroying earthworms.

There is also a constant demand for information of quite a different kind, which relates to the culture and care of earthworms for commercial purposes or for use in angling. An account of these worms from both points of view is therefore given in this bulletin.

Earthworms belong to a somewhat lowly organized group of animals known to science as the small-bristled roundworms.[2] Most of them, as their name implies, live in the soil; but some kinds of earthworms inhabit either the water or the soil, and some, comprising a considerable group, are able to live constantly in the water. Only earthworms inhabiting the soil are considered in this bulletin, and of these the kinds or species belonging to a family called the Lumbricidae are of chief significance. Fully matured members of this group constitute what are variously known throughout the country as angleworms, dewworms, night crawlers, earthworms, fishworms, rain worms, etc. The last term is a translation of the German common name and is a very appropriate one, as these creatures crawl from their burrows by tens of thousands during heavy rains at night, especially in early spring. The negro boys of Washington, D. C., are said to call them "night lions" or "night-walkers."

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[1] DARWIN, C. THE FORMATION OF VEGETABLE MOULD, THROUGH THE ACTION OF WORMS, WITH OBSERVATIONS ON THEIR HABITS. 326 p., illus. New York. 1882.

[2] Oligochaeta.

Earthworms thrive in almost all kinds of soils but they prefer those containing considerable organic matter and they must have abundant moisture. For this reason they are least numerous in very sandy areas. They commonly inhabit the upper 18 inches of the soil, but Darwin has shown that they may descend as much as 6 feet, or even more, when necessary. He showed also that these worms constitute an important agency in maintaining fertility by bringing to the surface, in a finely divided state, large quantities of soil from beneath, mingling with it half-decayed leaves and other organic matter, and thus aiding in the maintenance of the conditions necessary for vigorous plant growth. Earthworms increase the nitrifying power of soils and, in short, put the soil in better physical and chemical condition for plant growth. It was estimated that in parts of England the quantity of earth thus excavated in one year amounted to 10 tons per acre. This upward transference of earth by worms also causes large and small stones to sink gradually into the soil, and instances are cited where in the course of 30 or 40 years very stony fields were converted by such means into smooth sod where scarcely a stone was visible. In point of fact, it was Darwin's conclusion that "It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures." It is apparent, therefore, that in their proper place earthworms are beneficial to agriculture. Like many other animals, however, they do not recognize man's desires, and frequently invade locations where they are not welcome.

FOOD OF EARTHWORMS

Earthworms feed partly on the soil. They swallow great quantities of earth, from which they digest the organic matter, both animal and vegetable. Their digestive apparatus is equipped with a gizzard-like organ by the aid of which they are able to grind up the tougher fragments of food. Darwin has shown that they are fond of either raw or cooked meat, seem especially eager to devour fat, and will eat sugar readily.

The mouth of the earthworm is devoid of teeth or other biting or gnawing apparatus, and consists of a simple sucking or grasping mechanism which is well supplied with powerful muscles. When an angleworm wishes to grasp any small object such as a blade of grass or a twig, it thrusts from its mouth an appendage which corresponds roughly to the tongue of a human being. This is used to oppose the snout of the worm just as one presses his thumb against his index finger, enabling it to grasp firmly any slender object. If the desired object be convex and of considerable bulk, this same tongue-like organ forms itself into a sucker which by atmospheric pressure sticks to any smooth surface, thus enabling the worm to move objects such as pebbles weighing even as much as 2 ounces. At least one kind of large tropical earthworm is able to make this sucking organ of assistance in climbing trees.

By the use of the apparatus just described the earthworm is enabled to draw leaves or other objects into its burrows. Fresh leaves are frequently taken into the burrow, and the worm then moistens the innermost ends of them with a secretion from its mouth, which starts fermentation and soon renders the leaves sufficiently tender to enable it to tear off fragments for its food. Among the favorite tree leaves thus treated are those of the wild cherry, lime, elm, and maple, while of the cultivated plants carrot, celery, cabbage, onion, horseradish, and turnip leaves seem to be preferred. Not infrequently blades of grass are eaten.

Earthworms have been accused of biting off young plants and dragging them into their burrows; but, if we may judge from the construction of their mouths, they are incapable of actually severing fresh growing plants. They are, however, very muscular and strong, and a large earthworm with its bristled tail firmly fixed within its burrow is able to exert a force quite sufficient to uproot delicate small plants. Instances have been observed where seedling plants of various kinds have been thus pulled up. Serious injury of this character to gardens has been reported from this country and Germany. That earthworms are actually responsible for any extensive, serious injury to larger garden plants seems highly improbable, as they are numerous in nearly all gardens, including those that show no injury.

HABITS AND SENSES

Earthworms crawl by means of alternate contraction and expansion of the muscular rings forming their bodies. In these movements they are helped by rows of very short, stiff bristles, placed along the sides of the body. When in their burrows they use these bristles as an important aid to locomotion.

Angleworms have no eyes and do not see in the true sense of the word. Nevertheless they are quite sensitive to light, as may be seen when a bright light is flashed suddenly upon them at night; this usually causes instant withdrawal into the soil. The writer has found, however, that earthworms are comparatively insensitive to red light, even when it is rather strong. Blue light, on the contrary, affects them quickly. This sensitivity to light evidently is restricted largely to the head or the forward end of the body, as may be demonstrated by flashing a light on the worms as they begin to emerge from the ground. The worms are said to be deaf, but they are very sensitive to air currents, and especially so to the slightest vibration of the earth or of any object that happens to be in contact with their bodies. On nights when high winds prevail earthworms usually are absent on the surface of the ground even when conditions of temperature and moisture are favorable for their appearance.

A German zoologist recently made the statement that the common earthworms are capable of producing an audible sound which apparently is voluntary. This statement may be verified by anyone who will collect a dozen or more large earthworms and confine them in a suitable container, with sufficient earth to cover them. If, after the container with its worms has been kept in a dark place for some hours, it be quietly approached the sound referred to can be distinctly heard by a person having ordinarily good hearing. It can be closely imitated by moistening the lips well and then opening and closing them without moving the jaw. This action results in a snapping sound not unlike the dripping of water from a leaking faucet. It is well known that in Java there is a monstrous earthworm several feet in length called *Perichaeta musica* Horst, which during the night makes a sharp, interrupted sound, apparently by rubbing the bristles on its body against a stone. It is argued that, since these sounds evidently are produced voluntarily by the worms, this necessarily implies the possession of a sense of hearing. To judge from Darwin's experiments, the possession of this sense seems improbable, but the subject is still under investigation.

Although their sense organs appear to be poorly developed, earthworms were found by Darwin to exhibit a surprising degree of intelligence in choosing the most efficient methods of handling the various materials used in plugging up the mouths of their burrows, and in lining the upper parts of them with leaves and similar substances.

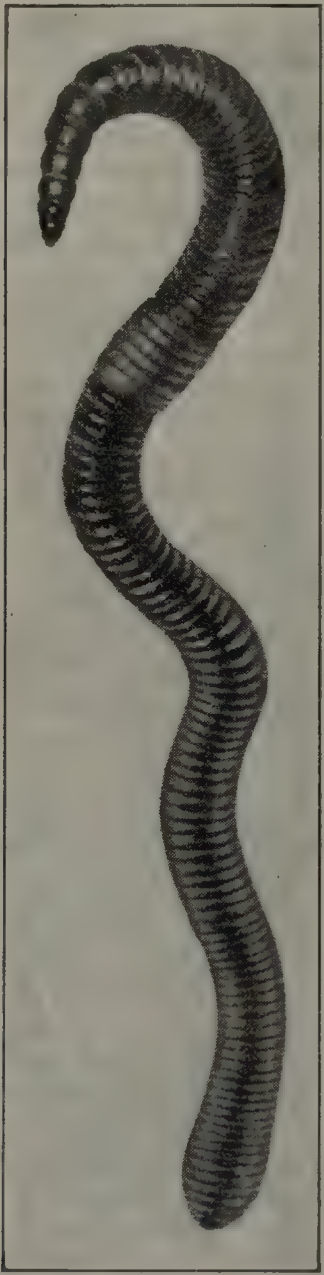

FIG. 1.—The rainworm, *Lumbricus terrestris*. Natural size. (Hofmeister)

HOW EARTHWORMS REPRODUCE

Every earthworm is both male and female. Each worm produces eggs from the forward half of the body near the flesh-colored, swollen band that may be observed there. The eggs are deposited within a ring of gelatinous matter that quickly solidifies and is then slipped over the head and assumes the shape of a capsule. Such capsules contain several eggs, together with a quantity of albumin to serve as food. The young worms emerge from the capsule fully formed and ready for their struggle for existence. The egg capsules of the common, large earthworms are about the size of a grain of wheat, which they otherwise resemble, and are found commonly in the soil. Much is yet to be learned regarding them, how soon they hatch, the exact number laid, the rate of growth, etc. The young are said to become adults in about three or four months.

COMMON SPECIES OR KINDS OF EARTHWORMS

The largest of the earthworms[3] commonly found in this country is a species long known in Europe, where it is widely distributed. (Fig. 1.) A large worm of this kind when fully extended may measure 10 inches or more. When contracted, such worms may be slightly larger in diameter than an ordinary lead pencil. Because of the large size of this species and its fondness for locating in well-kept grass plots, where it may become numerous enough to loosen the roots of the grass and throw up unsightly hillocks of soil, it is of considerable economic importance. According to Frank Smith, an eminent American authority on earthworms, it is, however, not so widely distributed throughout this country as is a somewhat smaller kind,[4] which is able to thrive in a great variety of locations and is equally at home in the soil of undisturbed woodlands, cultivated fields, or even bottom lands along rivers. Doctor Smith says that there is scarcely one of the States where collections have been made in which this worm has not been found abundantly. It is indistinguishable from the larger species except by its generally smaller size and by technical characteristics apparent only to an expert.

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[3] *Lumbricus terrestris* L.

[4] *Helodrilus caliginosus* Savigny.

Among the common species of earthworms which are of no great economic importance is a slender, foul-smelling worm[5] ringed with maroon and yellow, which is found in old manure, compost heaps, and tanyards. (Fig. 2.) This species is known as the "brandling" in Great Britain, where it is an especial favorite of trout fishermen. It is commonly known in the United States as the manure worm or "stinking fishworm." Another common kind of earthworm is the green Helodrilus.[6] It is found in the Western Hemisphere from Greenland to Guatemala.

The largest earthworms inhabiting the eastern part of the United States do not much exceed 12 inches in length. The average length of 50 large worms collected in Maryland, near Washington, D. C., was 8 inches. In Africa (Natal), Ceylon, and Australia, however, are found giant earthworms which are from 3 to 6 feet long.

BLOODWORMS

There are two quite similar species of marine, or ocean-dwelling, worms commonly sold on the Atlantic seaboard as bait for salt-water and anadromus[7] fishes. Fishermen know these forms as "bloodworms" because of the considerable quantity of red blood with which the body cavity is filled. As they constitute a very effective bait, there is a regular commerce in these worms, and the bulk of the supply comes from the Atlantic shore of Long Island, particularly from the vicinity of Jamaica Bay. The wholesale dealers ship them packed in a seaweed known as "sea cabbage." They are placed in a closed container and kept in a refrigerator pending sale.

Bloodworms inhabit the sandy and muddy ocean beaches from low water mark to a depth of several fathoms. They have the habit of burrowing into the bottom by coiling themselves into a spiral like a corkscrew and rapidly revolving their bodies in a manner similar to the action of that supposedly obsolete instrument. Correspondents frequently inquire whether such worms can be cultivated and whether it is possible to feed them in captivity. These worms feed only

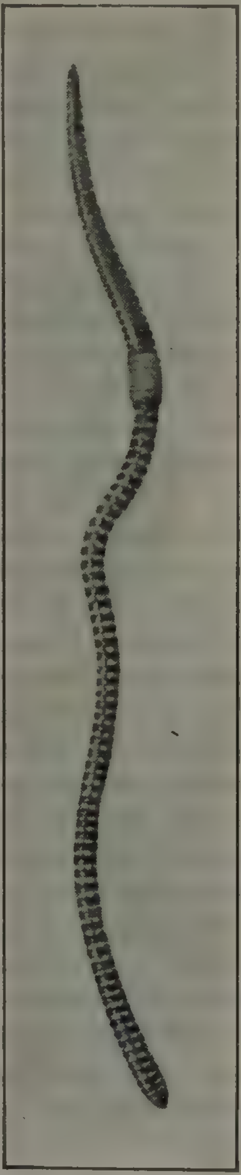

FIG. 2.—The brandling, or stinking earthworm, *Helodrilus foetidus*. Natural size. (Hofmeister)

on smaller marine animals in the ocean and can not be cultivated elsewhere or induced to feed in captivity.

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[5] *Helodrilus foetidus* Savigny.

[6] *Helodrilus chloroticus* Savigny.

[7] Fishes which, at certain seasons, ascend rivers from the sea for breeding purposes.

USES OF EARTHWORMS

In addition to their value as an agency in the enrichment of the soil, earthworms contribute importantly if unwillingly to the sustenance of creatures that appeal to the aesthetic side of man's nature. They furnish food for song birds in the early spring, at a time when the supply of seeds and berries is at its lowest ebb and long before insect food becomes plentiful. Among the most appreciative patrons of this item of food is our familiar and well-beloved robin. The dexterity and facility with which this alert and vigorous bird can yank a large earthworm from its burrow is a source of wonder and amusement even to the casual observer.

Most of the various kinds of domestic poultry and their game-bird relatives feed to some extent upon earthworms. In this connection it has been shown experimentally that earthworms may swallow the eggs or larvae of the roundworm known as the gapeworm, which is the cause of gapes in chicks, and that when chicks eat earthworms which have these gapeworm eggs or larvae in them, the chicks may contract gapes. This disease has a high mortality for these young birds. Chicks are also infected by swallowing the gapeworm eggs or larvae quite apart from earthworms, but it is possible that earthworms are important as sources of infection with gapes. Recently it has been shown[8] that turkeys constitute a normal host for gapeworms and are largely responsible for the infection of chickens, entirely independent of earthworms, where these birds are permitted to run in company.

From time immemorial earthworms have been used by anglers as a lure for the taking of fresh-water fishes, and they constitute the most generally available and effective bait known for this purpose. The earliest published work in the English language on angling is entitled: " Fysshynge Wyth an Angle," and is said to have been written by Julia Berners, an English Benedictine nun, and was published in the Book of St. Albans in 1496. It contains explicit directions regarding the best kinds of worms for such uses and the places where they are to be sought.

Requests for information on finding and caring for earthworms are constantly being received by this department. Most inquiries of this kind relate apparently to the large rainworms or night crawlers, but, judging from the statements of correspondents, fishworms of any kind find a ready market throughout the summer-resort sections of the United States.

METHODS OF COLLECTING EARTHWORMS

The burrows of earthworms are often well concealed and, even where numerous, may not be noticed by the uninitiated. The worms have the habit of plugging the entrances to their tunnels with various materials, such as leaves, seeds, twigs, or pebbles, which remain until the inhabitants emerge. Some of these objects are known to serve as food, but others, such as pebbles, bits of concrete, and cherry stones, evidently have no such use. They aid in concealment, and possibly serve to exclude both the sunlight and some of their more insidious enemies, such as the centipedes mentioned elsewhere in this bulletin.

During the more humid portions of the year earthworms ascend to the surface of the soil in the evening, to feed and to mate, and very probably for purposes of migration. That they emerge in great numbers during rains at night and travel considerable distances is a fact that is obvious. Some observers believe that the worms are forced from their burrows to avoid drowning.

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[8] B. H. RANSOM, THE TURKEY AN IMPORTANT FACTOR IN THE SPREAD OF GAPEWORMS. U. S. Dept. Agr. Bul. 939, 13 p. 1921.

Although the common way of obtaining earthworms for angling purposes is by recourse to the shovel, garden fork, or mattock, this is by no means the easiest or most effective method of collecting them. They may be more readily gathered by means of a lantern or flash light, after dark, on almost any piece of well-fertilized sod, especially where there are a few large trees to furnish both leaves for food and shade from the summer sun. If a flash light be used it is well to subdue the light by covering the lens with tissue paper or a thin handkerchief, as the worms instantly withdraw into their burrows when too bright a light is flashed suddenly upon them, and not many creatures can move more quickly than a badly frightened earthworm. The best light for this purpose is a flash light fitted with a red glass, as red light does not frighten the worms.

It is claimed that there are several other successful methods of securing earthworms. Among these are tapping or hammering on the soil surface and the so-called "fiddling." Both of these methods doubtless are based on the fact that when soil containing earthworms is agitated this action induces some of the worms within the disturbed area to emerge from their burrows. In the first method an area of ground that bears evidences of the presence of earthworms is located. Then the collector hammers or knocks on its surface to induce the worms to emerge. A variation of this method is to drive a wooden stake into the soil to a depth of about 10 inches, and then to knock on the side of it until the worms come up. The writer, in Maryland, near the District of Columbia, has tried both of the latter plans without success. In this case the soil was a heavy clay, inhabited by a common large earthworm or night crawler. It is, of course, quite possible that in a different soil, or in the presence of other species of worms, favorable results could be obtained.

In the "fiddling" method, a stake similar to that already described is used, but, instead of knocking on it, the operator rubs the side of a thin board across the top of the stake. This produces in the stake a vibratory or shuddering action which is, in turn, transmitted to the soil. It is said that in Florida this method results in the immediate appearance of the worms within a radius of from 25 to 30 feet of the operator. In some other regions the method has been unsuccessful, and it seems highly probable that the trusty garden fork or the night-collecting method previously described will be found to bring more consistent and satisfactory results.

In dry weather earthworms descend more deeply into the soil, and come to the surface in smaller numbers at night. At such times, indeed, they may seem to be entirely absent. Usually, however, it will be found that if the soil around their burrows is thoroughly wetted down by sprinkling with a garden hose shortly before sundown, the worms will come eagerly to the surface after dark, provided the night temperature does not fall much below 40° F. In case it is desired to obtain earthworms during cold weather, they may usually be found by digging beneath compost heaps or manure piles. Earthworms are hardy creatures, and a brief period of mild weather brings them to the surface even in February, in the latitude of Washington, D. C. The writer has observed them mating in considerable numbers when the air temperature was 41° F.

The worms should be collected in a clean vessel, such as a fruit jar or a thoroughly cleansed tin can. They should not, however, be allowed to remain indefinitely in a metal container, as they survive much longer and in better condition when kept in an earthen crock or a tight wooden pail or box. The writer has found a 3-gallon stoneware crock, containing about 8 inches of mellow earth covered with a 2-inch layer of plant material such as sphagnum moss, sods, or even common chickweed, excellent as a storehouse for 100 or more large earthworms. In such a container, kept in a cool corner of the cellar, the worms remain in good condition for weeks; and almost indefinitely when fed a little finely chopped raw beef suet, crumbled hard-boiled egg, or even finely divided bread crumbs. These may be sprinkled upon the surface of the soil in the container, underneath the plant material. Either sweet or sour milk may be fed, but becomes offensive unless the earth is changed frequently.

STORING AND REARING EARTHWORMS

Where it is desired to store or rear earthworms for sale, a larger container placed out of doors is desirable. For this purpose a tight box, preferably constructed of tongue-and-groove material, is suitable. It should be at least 18 inches deep and of a size proportionate to the number of worms it is proposed to handle. A box 18 by 36 by 60 inches will serve very well for several hundred large worms. If the exterior of the box is well tarred it will last much longer in the soil than if untreated. Creosote is not recommended for this purpose because of its possible effect on the worms. In any case the inside of the box should not be treated with either of these substances, but, if so desired, it may be waterproofed by painting with hot paraffin wax.

The box should be supplied with a well-fitting lid, which should project sufficiently over its edges to prevent flooding during heavy rains. It should be set into the soil with the upper 2 or 3 inches projecting above the surface, in a fairly well-drained place, and should be shaded to prevent the temperature of the interior from rising too high in midsummer. A temperature of 75° F. or higher is quickly fatal to earthworms under most conditions. The box should be nearly filled with good soil which is damp but not wet. The richer this soil is in humus the better, as the worms require less artificial feeding in rich soil than in poor. A loamy soil is preferable, but very sandy soil is not suitable.

After the box has been stocked with worms, the surface of the soil may be covered with a layer of cut sods if desired, but a very excellent covering consists of well-decayed leaves, which form a considerable part of the natural food of earthworms. In dry weather it will be necessary to moisten the soil in the box occasionally, but in doing so care should be taken to avoid flooding it, as too much water is injurious to the worms. Freezing kills earthworms, and in severe climates, where the soil commonly freezes to a depth of a foot or more during the winter, it may be necessary to protect the soil in the box from frost. Winter protection may be secured by giving the box a generous covering of half-decayed manure or compost.

Although under the conditions just described earthworms can live for a long time without artificial aid, it will be found desirable to feed them a little fat occasionally, in the form of chopped beef suet, or a little sugar in some cheap form. One dealer in earthworms claims to have been very successful in feeding worms ordinary molasses spread on the surface of gunny sacking or burlap, which is simply laid upon the soil with the sticky side down and moistened occasionally. The worms undoubtedly will reproduce more rapidly and be more thrifty if they are well fed. When the worms obtain insufficient food they shrink rapidly in size and lose vigor.

PREPARATION OF EARTHWORMS FOR ANGLING OR FOR MARKET

Although earthworms may be marketed or used freshly dug from the ground, they are much more desirable, will live longer on the hook, and will take more fish if well "scoured" before use. This fact is well known to all skilled bait fishermen, and it is probable that the knowing ones would be willing to pay a premium for such worms. This scouring process has been known for hundreds of years and was well described by Izaak Walton in 1653.

To carry out this "scouring" process a quantity of sphagnum moss such as is used by nurserymen in packing plants for shipment is put into a stoneware crock or tight wooden box. This moss, which grows in shady, swampy woods, should be well moistened, but the excess water should be wrung out before the moss is placed in the container. The worms should be placed in the moss for at least two days, and preferably three or four, and kept in a cool place. At the end of this period they should be almost transparent, tough, and lively. In case it becomes necessary to keep them in the moss for some weeks, a little sweet milk should be poured over them at intervals of about a week, but the moss should be washed and wrung out in clean water every week or 10 days.

A PRACTICAL BAIT BOX

In warm weather the fisherman, while on the stream, often finds it a difficult matter to keep worms alive and in good condition. The ordinary tin or aluminum bait boxes, such as are commonly sold by tackle dealers, serve to conduct to the worms the heat of the sun as well as that of the fisherman's body. This heat may cause their death and thus deprive the angler of bait at a most interesting moment of the day's sport. Figure 3 illustrates a worm box, designed and constructed by the author, which has given perfect satisfaction over a period of two years. It is made of galvanized sheet iron and lined with sheet cork. This lining is one-fourth of an inch thick, and was given two heavy coats of collodion on the inside to make it waterproof and sanitary. The metal box is provided with a canvas jacket that is laced on, so that it may be easily removed for cleansing. In practice this jacket is kept wet, and the evaporation from it causes absorption of heat and keeps the worms cool and lively even on the hottest of summer days. Any tinsmith can construct the metal box, and the sheet cork may be obtained from a dealer in shoe findings. In case the collodion is not obtainable, an excellent substitute is celluloid dissolved in acetone. Old photographic celluloid films furnish a ready source of the former, and acetone is sold by nearly all drug stores and is cheap.

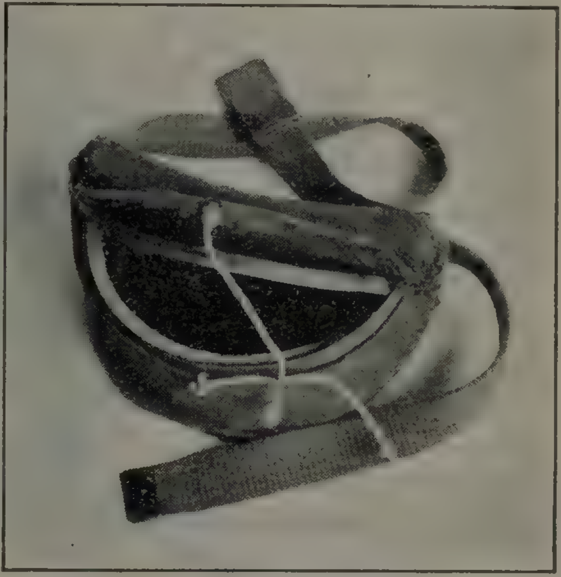

FIG. 3.—A bait box that keeps worms cool and alive in hot weather

NATURAL ENEMIES OF EARTHWORMS

In addition to the fisherman with his ever-ready garden fork and tin can, the earthworm has numerous natural enemies that are constantly on the alert. Song and game birds, as well as domestic poultry, patrol the meadows and woodlands during the day, while the ubiquitous toad, with his huge appetite and sticky, darting tongue, stalks earthworms ceaselessly during the early hours of spring and summer nights. Some of the smaller species of harmless snakes, especially the common and widely distributed garter snakes, feed largely on earthworms at times. The Bureau of Biological Survey has identified earthworms in the stomachs of no fewer than 45 species of birds. The crow seems to get more egg capsules of the worms, and the jacksnipe, woodcock, starling, and robin seem to get more adult worms. Earthworms are an important item of food to the four species last named.

This warfare, however, is not confined to the mere surface of the soil. The earthworms are by no means safe even in the fastness of their underground burrows. Here they are pursued relentlessly by the voracious shrews and moles, which subsist largely upon these creatures. Centipedes and "thousand leggers" follow the worms even to the depths of their longest tunnels. (Fig. 4.)

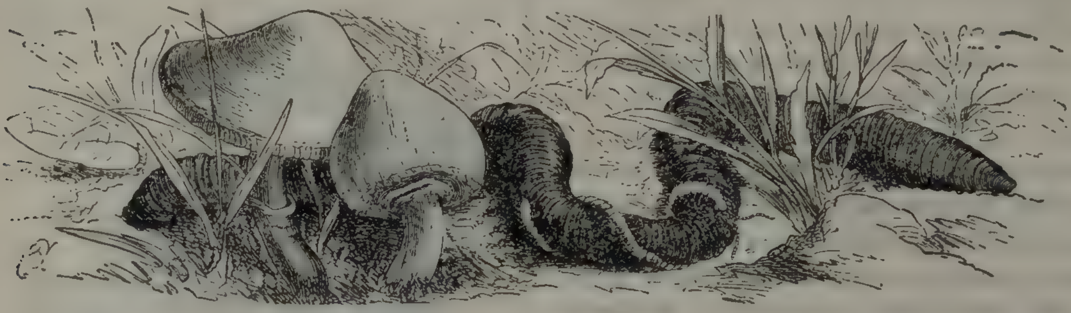

FIG. 4.—A centipede, a species of Geophilus, attacking a large earthworm. (Brehm)

In addition to these formidable foes some kinds of earthworms have still another enemy in the form of a two-winged fly (fig. 5), which superficially resembles closely the common house fly.[9] In point of fact this insect, which is known as the cluster fly[10] and often enters houses in large numbers in the fall, is commonly mistaken for the house fly. By the use of a low-power magnifying glass, however, the cluster fly is easily distinguishable from the house fly, as it has a coat of downy yellow hairs upon its back and sides. This down is entirely absent in the house fly.

For a long time the manner of life of the cluster fly was unknown, but this problem was solved in 1908, by David Keilin, of the Quick Laboratory, at Cambridge, England. He found that the larva or maggot of this fly was parasitic upon certain species of earthworms.[11] The fly's eggs are deposited on or in the soil and hatch in from five to seven days. The minute maggots then seek the worms and bore into their bodies, where they continue to feed until eventually the worms are destroyed. Subsequent investigations carried on by American entomologists[12] confirmed in a general way these facts as applied to the life history of the insect in this country, but it was found that in summer the eggs hatch in about three days. It was found, also, that there may be several generations of the fly in a year[13] and that it is possible for the insect, under certain conditions, to undergo its complete cycle of development in from 27 to 39 days. The cluster fly itself falls a victim in great numbers to a fungous disease which attacks it during the warm, humid weather of midsummer. At this time even the newly emerged flies may be observed, stilled in life-like poses, attached to the leaves of plants, where they have been killed by the action of this fungous enemy.

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[9] *Musca domestica* L.

[10] *Pollenia rudis* Fab.

[11] *Helodrilus chloroticus* Savigny and *H. roseus* Savigny.

[12] WEBB, J. L., and HUTCHISON, R. H. A PRELIMINARY NOTE ON THE BIONOMICS OF POLLENIA RUDIS, FABR. IN AMERICA. Ent. Soc. Wash. Proc. 18: 197–199. 1916.

[13] GARRISON, G. L. REARING RECORDS OF POLLENIA RUDIS FAB. (DIPT.: MUSCIDAE.) Ent. News 35: 135–138. 1924.

GETTING RID OF EARTHWORMS WHERE THEY ARE A NUISANCE

IN LAWNS AND GOLF GREENS

Although, generally speaking, earthworms must be regarded as beneficial organisms, they often appear in places where they are objectionable. Many people object strenuously to their presence in lawns, especially where they become abundant enough to be very apparent. It is likely that in many cases this objection is founded upon a wrong conclusion. The worms by choice locate most abundantly in the dense shade of trees or shrubs, where, on account of the lack of sunlight, the grass grows but thinly or not at all. As the hillocks or heaps of castings produced by the worms are most obvious in such locations, the hasty conclusion is reached that the worms prevent the growth of the grass. They may, however, be nearly as plentiful, though unnoticed, in the dense turf, which continues to thrive in spite of their presence. It is true that the worms may occur in such numbers as to render the surface of the soil lumpy and thus interfere with the operation of a lawn mower. In such cases relief may be had by brushing or raking the lawn occasionally to break up and destroy the worm casts.

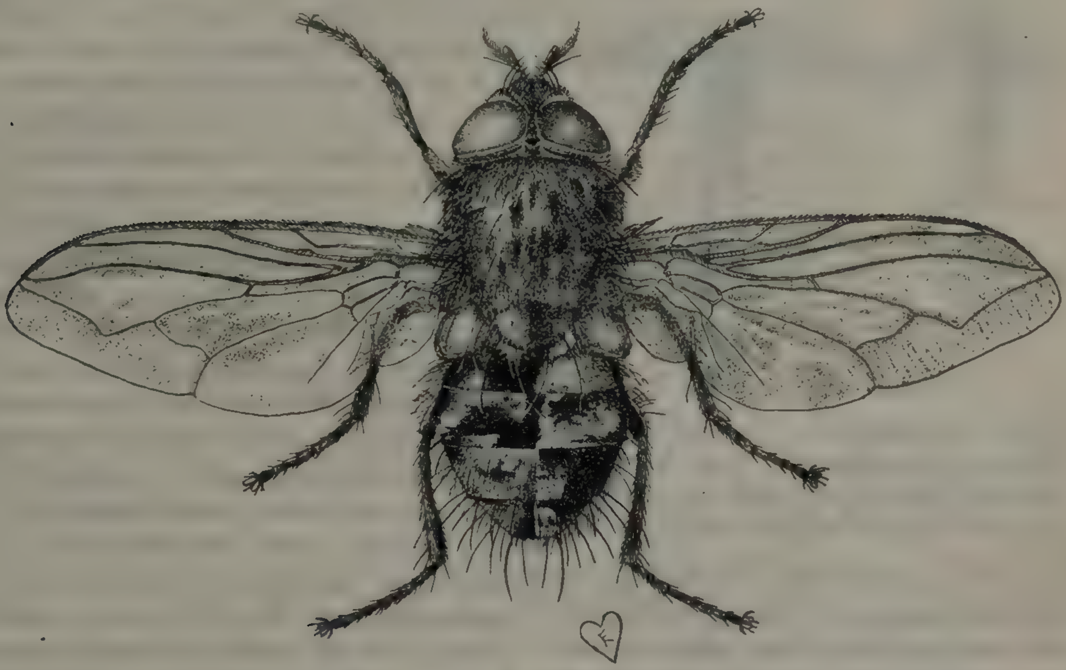

Fig. 5.—The cluster fly. Enlarged 10 diameters

A similar condition of the soil, though much more serious, is produced in lawns throughout the southern half of the Eastern States late in the summer or in the fall by the boring of the grubs of the green June beetle.[14] Many persons mistake this work for the castings of earthworms, but the grubs make larger burrows and throw up much greater quantities of earth than do the worms. The burrows of these grubs may be distinguished from those of even the largest earthworms of this country by their somewhat larger size and the character and shape of the castings found about the mouths of the tunnels. Those of the grubs are shaped like a rectangular pillow or tablet, whereas the castings of the worms are always more or less spiral or vermiculate. (Fig. 6.) In the latter part of summer and in the fall the grubs begin to burrow deeply into the soil for the winter, and where they are numerous at this time they become a real menace to the grass. The hillocks they create may measure 3 or 4 inches, or even more, in diameter. Frequently the grubs loosen the roots of the grass about their burrows sufficiently to kill it over a space several inches in diameter. The methods ordinarily recommended for the destruction of earthworms may have little effect on such grubs. It is important, therefore, to ascertain whether the injury is caused by earthworms or by the grubs of the green June beetle before attempting to apply a remedy.[15]

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[14] *Cotinis nitida* L.

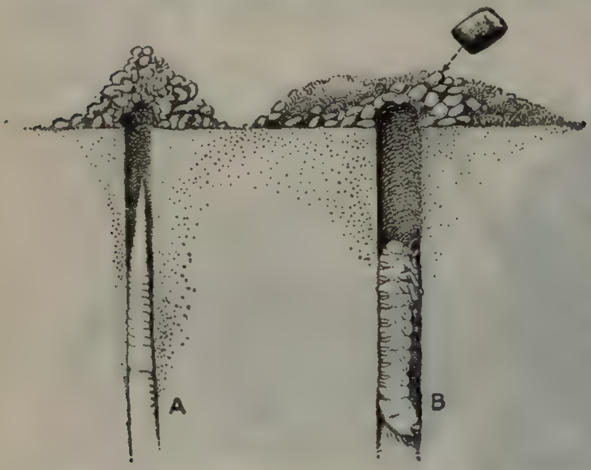

Fig. 6.—Comparison of A, burrow and castings of an earthworm, with B, burrow and castings of the grub of the green June beetle. Both about natural size

The presence of earthworms on the putting greens of golf links is very objectionable, and in recent years attention has been paid to methods of destroying them in such locations.

Corrosive sublimate (bichloride of mercury) is the least expensive efficient vermicide thus far discovered, although several other poisons are more or less effective. R. A. Oakley, of the United States Department of Agriculture, has determined the dosage rather carefully and is responsible for the following suggestions:[16]

"From the standpoint of economy and efficiency, corrosive sublimate is without question the best substance to use to rid turf of earthworms. Furthermore, it is exceedingly efficient if properly used . . . there are many who have injured their turf by applying it improperly. Corrosive sublimate may be applied either in a water solution or mixed with sand or similar inert matter. The liquid form is regarded by many as preferable. . . .

"Two or not to exceed 3 ounces of corrosive sublimate dissolved in 50 gallons of water are sufficient for 1,000 square feet of green. After the solution is applied it should be followed with at least twice the quantity of water to wash it thoroughly into the soil. If it is desired to apply the corrosive sublimate dry, it should be mixed at the rate of 2 or 3 ounces to 2 cubic feet of dry sand, and the mixture scattered evenly over 1,000 square feet of green. Liberal watering should follow. When corrosive sublimate is applied in the way and at the rates suggested, especially if water is used freely afterward, no injury to the turf should result. In very hot, dry times applications as suggested may cause a very slight burning of the turf; and furthermore, it is rarely that earthworms are in action at such times. The effect of burning from the suggested rates, however, will not be lasting or serious."

In the case of comparatively small areas of grass an ordinary sprinkling pot may be used to apply the poison solution. As corrosive sublimate rapidly corrodes metals, the solution should not be allowed to stand in a metal container, and immediate washing is advised in case a sprinkling pot is utilized for this purpose. After the application of the solution the worms usually begin to come to the surface within a very few minutes, and they should be gathered up and disposed of immediately. There is a possibility that if they are permitted to remain, some birds might be killed or injured by the poison left on the bodies of the worms.

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[15] For methods of destroying green June beetles see the following: McKinney, K. B., and Milam, J. THE GREEN JUNE BEETLE LARVA IN TOBACCO PLANT BEDS. U. S. Dept. Agr. Farmers' Bul. 1489, 6 p., illus. 1926.

[16] Oakley, R. E. EARTHWORMS. U. S. Golf Assoc. Green Sect. Bul. 4: 115–116. 1924.

CAUTION: Where corrosive sublimate is used it should be remembered that it is a dangerously poisonous substance and great care should be observed in handling it. All packages of the poison should be plainly labeled, and all vessels in which mixtures are made should be most scrupulously cleansed by washing after use.

The results of three years' application of ammonium sulphate to sod on the experimental farm of the Department of Agriculture at Arlington, Va., for fertilizing purposes, have shown incidentally that earthworms were eliminated from the plots where this chemical was used. When applied to soils which are naturally neutral or slightly acid in character, this fertilizer creates a strongly acid condition that is distasteful to the worms, and they disappear. Ammonium sulphate, either dissolved in water or mixed with dry sand, may be applied for this purpose at the rate of 3 pounds to 1,000 square feet of surface. In the case of strongly alkaline soils this treatment is not recommended, as it has little or no effect on the worms. This fertilizer should not be applied where it is desired to retain clovers in the sod, as these plants do not thrive in acid soils. It should be understood also that in any case the effect of ammonium sulphate on the worms is slow as compared with that of the highly active and poisonous bichloride of mercury.

Very recently it has been determined that powdered arsenate of lead, such as is in general use for insecticidal purposes, is efficient in destroying earthworms.[17]

Caution should be observed in applying arsenate of lead to some varieties of grasses. In the case of the various varieties of bent grass, such as are favored for use on golf greens, arsenate of lead has been found perfectly safe as a vermicide, but its application to annual bluegrass (*Poa annua*) and crabgrass has resulted in a decided check in the growth of these grasses. As a vermicide, the arsenate of lead may be applied at the rate of 1 pound to 1,000 square feet of surface. Uniform distribution is necessary, and may be obtained by mixing 1 pound of the dry arsenate with about 2 cubic feet of dry sand or loam, and broadcasting the mixture evenly over the ground. The application should be made when the grass is dry. This dose should be repeated every three of four weeks until the worms or the evidences of their presence disappear.

In very dry weather the worms will not come to the surface unless it is moist. For this reason the soil should be thoroughly sprinkled with a hose before any vermicide is applied.

In making new seedings of grass where worms are likely to be troublesome, the arsenate of lead should be worked into the soil to a depth of 1 or 2 inches.

Many of the proprietary vermicides contain mowrah meal as their active principle. This consists of the ground seeds of the madhuca tree of the East Indies from which the oil has been expressed. When fresh, this meal is an effective worm killer and may be applied to the grass in a dry condition at the rate of 15 pounds to 1,000 square feet of surface. The grass should then receive a liberal watering. Where this method of application is used there is no danger of burning. Mowrah meal deteriorates with age, especially when stored in a damp place, and is then ineffective. It has the advantage of being comparatively harmless to man and on this account is preferred for use on golf courses by some keepers.

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[17] LEACH, B. R. FURTHER EXPERIMENTS IN THE CONTROL OF JAPANESE BEETLE GRUBS. U. S. Golf. Assoc. Green Sect. Bul. 8: 28–33, illus. 1928.

IN FLOWERPOTS AND FLOWER BEDS[18]

Often the soil of flowerpots and flower beds becomes overstocked with earthworms, and in many cases injury to the plants results. The worms are brought in with the soil or manure and under favorable conditions multiply rapidly. Their habit of tunneling through the fine root system is often damaging or destructive to cultivated plants.

Limewater (saturated) applied freely to the soil will destroy earthworms and will not injure the plant. About 2 cupfuls of unslaked lime placed in a 3-gallon bucket of water, thoroughly agitated, and then allowed to settle, will furnish the desired clear liquid. Tobacco dust thoroughly worked into the soil is effective and at the same time has some value as a fertilizer.

Drenching the soil with a weak solution of mercuric chloride (corrosive sublimate), as is recommended for use out of doors, will destroy the worms. It may be prepared by dissolving one-half ounce of this chemical in 4 gallons of water. The caution is repeated that as corrosive sublimate is a deadly poison, it should be stored and handled with extreme care.

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[18] Contributed by C. A. Weigel.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1570

MOSQUITO REMEDIES AND PREVENTIVES

MOSQUITOES are man's inveterate tormenters and many of them are his dangerous foes. If they were merely a bothersome plague there would be ample justification for unrelenting warfare against them. When, however, we consider that a certain kind of mosquito found in houses in the South will convey yellow fever and breakbone fever from infected to healthy persons and that certain other kinds, by disseminating malaria, render many regions of great fertility almost uninhabitable, no argument for fighting them is necessary.

Swamps, ponds, and marshes are not the only places which breed mosquitoes. A little rain water in an old tin can, an uncared-for sewer trap, or an undrained roof gutter, if neglected, will supply mosquitoes for a neighborhood.

This bulletin describes the measures, substances, and materials, both offensive and defensive, that have been found most effective against these diminutive but serious menaces to our comfort and health. It is a revision of and supersedes Farmers' Bulletin 444, entitled "Remedies and Preventives Against Mosquitoes."

Washington, D. C. **Issued August, 1928**

MOSQUITO REMEDIES AND PREVENTIVES

By L. O. Howard, *Principal Entomologist*, and F. C. Bishopp, *Principal Entomologist, Division of Insects Affecting Man and Animals, Bureau of Entomology*

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IMPORTANCE OF ANTIMOSQUITO WORK

SINCE the discovery that mosquitoes are not only nuisances, but also conveyors of malaria, yellow fever, filariasis, and dengue or breakbone fever, a great deal of remedial work has been done by individuals and communities, and, during the last few years, by the Medical Department of the United States Army and the Public Health Service in the vicinity of camps and cantonments. Many remedies and plans of action have been tested on a large scale, and what follows is a summary of the results.

PROTECTION FROM BITES

PROTECTIVE LIQUIDS

Spirits of camphor or pine oil rubbed upon the face and hands will help to keep mosquitoes away for a time, and this repellent action is also a well-known property of oil of pennyroyal. None of these substances are durable; that is to say, a single application will not last through the night. Oil of citronella is one of the best substances to be used in this way. The odor is objectionable to some people but not to many, and it is efficient in keeping away most mosquitoes for several hours. The best formula tried by the writers was sent to them by C. A. Nash, of New York, and is as follows:

Oil of citronella	1 ounce
Spirits of camphor	1 ounce
Oil of cedar	½ ounce

Ordinarily a few drops on a bath towel hung over the head of the bed will keep the common house mosquitoes away. Where they are very abundant and persistent a few drops rubbed on the face and hands will suffice. Even this mixture, however, loses its efficacy toward the close of a long night. It is the habit of the yellow-fever mosquito[1] to begin to bite at daylight. By that time the average person is sleeping very soundly, and the effects of the mixture will usually have passed largely away. It follows that in the Southern States, where this mosquito occurs, these protective mixtures are not supposed to be as effective as they are in the North. As a matter of fact, however, this last mixture, could it be applied shortly before dawn, would give satisfactory protection.

Oscar Samostz, of Austin, Tex., recommends the following formula:

Oil of citronella	1 ounce.
Liquid petrolatum	4 ounces.

This mixture greatly retards the evaporation of the oil of citronella.

B. A. Reynolds has used successfully in New Orleans 20 minims of oil of citronella to the ounce of petrolatum or lanolin.

Pure kerosene has also been used extensively in the Philippines and to some extent in this country.

SCREENS AND CANOPIES

Such obvious measures as the screening of houses, the use of netting for beds, and the wearing of veils and gloves after nightfall in badly infested regions need no detailed consideration. Screening of houses can not be too carefully done, and adjustable, folding, or sliding window and door screens seem never to be tight; even with well-fitted screens there are often opportunities for mosquitoes to enter; constant care and vigilance alone will prevent this. In certain seasons in mosquito regions, mosquitoes will attempt to make their way through screens and are often able to do so. When they are very numerous, wire screens should be painted lightly with kerosene or oil of citronella.

With bed canopies there should be ample material to admit of a perfect folding of the canopy under the mattress, and the greatest care should be taken to keep the fabric well mended. It often happens in mosquito regions that little care is taken of the bed nettings in the poorer hotels, and it is necessary for perfect protection that a traveler in the Southern States carry with him a pocket "housewife" and he should carefully examine his bed netting every night, prepared to mend all tears and expanded meshes. Veils and nettings for camping in the Tropics or other regions where mosquitoes abound are absolutely necessary. Light frames are made to fit helmetlike over the head and are covered with mosquito netting. Similar frames, readily folded into a compact form, are made to form a bed covering at night, and every camping outfit for work in tropical or malarial regions should possess such framework and plenty of mosquito netting as an essential part of the outfit.

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[1] *Aëdes aegypti* L.

The size of the mesh in mosquito bars and window screens is important. Eighteen meshes to the inch, or 16 to the inch if insect screen cloth of heavy-grade wire is used, can be relied upon to keep mosquitoes out, but 14 to the inch admits some of them. However, any good 16-mesh screen cloth will exclude most of the mosquitoes, and this mesh is now generally available. Although copper screen cloth is more expensive than the black or metal coated, its durability is such as to commend its use, especially on the coast or in areas where there is considerable humidity. Painted and galvanized screen cloths will not last long under such conditions, although an occasional coat of screen enamel will greatly lengthen the life of such screens. A coat of enamel is also useful in reducing the size of the openings in 14-mesh screen to exclude small mosquitoes.

SCREENING BREEDING PLACES

Where the rain-water supply is conserved in large tanks, as in cities in the Gulf States, screening is necessary and is now rather generally enforced. Rain-water barrels everywhere should be screened in the same way, except where fish are used to kill the early stages of mosquitoes. A cheap cover for a water barrel can be made by covering a large iron hoop with a piece of stout calico or sacking, free from holes, in such a manner that a good deal of sag is left in the material.

SMUDGES AND FUMIGANTS

Anything that will make a dense smoke will drive away mosquitoes, and various smudges are used by campers. For household use a number of different substances have been tried.

PYRETHRUM POWDERS

Pyrethrum powders, known to the trade as Dalmatian insect powder, Persian insect powder, buhach, and otherwise, are very effective when fresh and pure. Pure powders are the finely ground flower heads of two species of composite plants of the genus Pyrethrum. The essential principle disappears with age and exposure. Pyrethrum powders are generally used dry, and are puffed or blown into crevices frequented by insects, or into the air of a room in which there are mosquitoes. The burning of the powder in a room at night is a common practice. The powder is heaped up in a little pyramid which is lighted at the top and burns slowly, giving out a dense and pungent smoke. Often the powder is moistened and molded roughly into small cones, and after drying it burns readily and perhaps with less waste than does the dry powder. Mosquitoes are stupefied by the smoke and fall to the floor, where they may be swept up and burned. With open windows and constant currents of fresh air this fumigation is not especially effective, and it is necessary, for protection, to sit in a cloud of smoke. The powder may be placed upon a metal screen above the chimney of a kerosene lamp, with the result that the vapor will be dissipated. This is said to be very effective. It is economical in powder, and the odor is slight. Another method of burning the powder is to puff it from an insufflator into a burning gas jet. In New Orleans it has been found that in order thoroughly to clear houses of mosquitoes pyrethrum must be burned at the rate of 1 pound of powder to every 1,000 cubic feet of space.

MIMMS CULICIDE

This mixture is made of equal parts by weight of carbolic acid crystals and gum camphor. The acid crystals are melted with a gentle heat and poured slowly over the gum, resulting in the absorption of the camphor and a final clear, somewhat volatile liquid with an agreeable odor. This liquid is permanent, and may be kept for some time in tight jars. Volatilize 3 ounces of this mixture over a lamp of some kind for every 1,000 cubic feet of space. A simple apparatus for doing this may be made from a section of stovepipe cut so as to have three legs and an outlet for draft, an alcohol lamp beneath, and a flat-bottom basin on top. The substance is inflammable, but the vapor is not explosive. The vapor is not dangerous to human life except when very dense, but it produces a headache if too freely breathed. Rooms to be fumigated should be made as nearly air-tight as possible.

SULPHUR DIOXIDE

Burning of flowers or flour of sulphur, or of lump sulphur, in a small pot, at the rate of 2 pounds of sulphur for each 1,000 cubic feet of space, is efficient against mosquitoes where fumigation in the case of possible disease-bearing mosquitoes is desired. Metal articles are tarnished by sulphur fumes and should be removed. The house should be closed as tightly as possible, including chimneys.

OTHER FUMIGANTS

According to the late John B. Smith, powdered jimson weed (*Datura stramonium*) can be burned to advantage in houses, 8 ounces being used to fumigate 1,000 cubic feet of space. He stated that it should be made up by the druggist with niter or saltpeter, 1 part to 3 of Datura, so as to burn more freely. According to Doctor Smith the fumes are not poisonous to human beings, are not injurious to fabrics or to metals, and can be used with entire safety. He suggested that it be burned in a tin pan or on a shovel.

USE OF SPRAYS IN DESTROYING MOSQUITOES

Destructive and repellent sprays may serve a useful purpose in combating mosquitoes within dwellings and other buildings. Probably the most effective and available spray for this purpose consists of a kerosene extract of pyrethrum. Many of the commercial fly and mosquito sprays now on the market are essentially of this composition.

In applying such sprays the infested building should be closed tightly and the spray applied freely with a good atomizer. Special attention should be given to spraying behind and beneath furniture and in closets and other protected places where the mosquitoes may be hiding. Not only are the mosquitoes which are struck by the spray killed, but if the air is well filled with the spray mist and the rooms are kept closed for some time, mosquitoes which are flying about are destroyed.

APPARATUS FOR CATCHING ADULT MOSQUITOES

An interesting homemade apparatus in common use in many parts of the United States is very convenient and effective. It consists of a tin cup or a tin-can cover nailed to the end of a long stick in such a way that a spoonful or so of kerosene can be placed in the cup, which may then, by means of the stick, be pressed up to the ceiling so as to inclose one mosquito after another. When covered over in this way the captured mosquito will attempt to fly, and will be caught in the kerosene. By this method perhaps the majority of the mosquitoes in a given bedroom—certainly all of those resting on the ceiling—can be caught before one goes to bed.

H. Maxwell Lefroy, when in India, made a trap consisting of a wooden box lined with dark-green baize and having a hinged door. The trap is 12 inches long, 12 inches broad, and 9 inches deep. A small hole, covered by a revolving piece of wood or metal, was made in the top of the box. Owing to the habit of mosquitoes to seek a cool, shady place in which to rest, such as a dark corner of the room or a book shelf, or something of that sort, they will enter the trap, which is put in the part of the room most frequented by mosquitoes, all other dark places being rendered uninhabitable so far as possible. They are driven out of book shelves with a duster or with tobacco smoke, and go into the desirable sleeping place for the day. The door is then closed and fastened, and into the small hole at the top of the box a teaspoonful or less of benzine is introduced. This kills all of the mosquitoes inside, and the box is then thoroughly aired and replaced. In this way Mr. Lefroy was very successful in catching mosquitoes. At one time he averaged 83 a day.

REMEDIES FOR MOSQUITO BITES

The most satisfactory remedy known to the writers, from their personal experience, has been moist soap. Wet the end of a piece of ordinary toilet soap and rub it gently on the puncture, and the irritation will soon pass away. Others have enthusiastically recommended household ammonia, or alcohol, or glycerin. One correspondent marks the puncture with a lump of indigo; another with one of the naphthaline moth balls; another with iodine. R. W. Anderson, of Wando, S. C., states that he has found that by holding his hand near a hot lamp chimney the irritation of mosquito punctures will be relieved instantly.

ABOLITION OF BREEDING PLACES

It has been found that, taking the group of mosquitoes as a whole, their breeding places are of the most diverse character. Some species, however, are restricted in the character of their breeding places. Certain forms, for example, breed only in tree holes; others in accumulations of water in epiphytic plants; other species breed only in the crabholes on sea beaches. Others have more general breeding habits and will live in almost any chance accumulation of water. Certain species breed only in the salt marshes and lay their eggs on mud. Others lay their eggs upon the surface of water. Certain of the species in the more northern States breed only in the pools formed by melting snow, and as these occur at only one time of the year there is but one generation, and the eggs are laid in midsummer or later in such hollows in the earth as will be filled with water from the melting snow in the ensuing spring. Another species, which is frequently very annoying, breeds only in certain permanent swamps, where the larva lives attached to the roots of certain aquatic plants. Still another breeds in the pitchers of pitcher plants (Sarracenia).

The house mosquito[2] in the North and the rain-barrel mosquito[3] and the yellow fever mosquito[4] in the South, however, breed in every chance receptacle of water about residences, and their destruction means the abolition or treatment of all such receptacles.

Where the rain-water barrel and rain-water tank are necessary they should be screened. About a given house the waste places in the immediate vicinity should be carefully searched for tin cans, bottles, and wooden or tin boxes in which water can accumulate and all such receptacles should be destroyed or carried away. It is a good practice to punch several holes in each can as emptied so that, wherever it may be finally deposited, water will not be held in it. The roof gutters of every building should be carefully examined to make sure that they are not clogged so as to allow the water to accumulate. Where the branches of tall trees overhang roofs this is especially likely to occur by the agency of falling leaves or twigs. The chicken pans in the poultry yard, the water in the troughs for domestic animals, the water cup of the grindstone, are all places in which these mosquitoes will breed, and water should not be allowed to stand in them for more than a day or so at a time.

In the South the water accumulating under water tanks should be treated or drained away. The urns in the cemeteries in New Orleans have been found to breed mosquitoes abundantly. The holy-water fonts in churches, especially in the South, have been found to breed many mosquitoes. In slightly marshy ground a favorite breeding place is the footprints of cattle and horses. In one country village, which contained many small vegetable gardens in clay soil, during a rainy season mosquitoes were found breeding abundantly in the water accumulating in the furrows in the gardens.

Even in the house these mosquitoes breed in many places where they may be overlooked. Where the water in flower vases is not changed frequently mosquitoes will breed. They will breed in water pitchers in unused guest rooms. They will breed in the tanks in the water-closets when these are not often in use. They will breed in pipes and under stationary washstands where these are not frequently used, and they will issue from the sewer traps in back yards of city houses during dry spells in the summer time when the sewers have not recently been flushed by heavy rains. In warehouses and on docks they breed abundantly in the fire buckets and in water barrels. Of course such places as these can not be abolished, but they should be treated in accordance with measures indicated in another section of this bulletin.

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[2] *Culex pipiens* L. [3] *Culex quinquefasciatus* Say. [4] *Aëdes aegypti* L.

In country houses in the South, where ants are troublesome, and where it is the custom to insulate the legs of tables with small cups of water, mosquitoes will breed in these cups unless a small quantity of kerosene is poured in. Where broken bottles are placed upon a stone wall, water accumulates in the bottle fragments after rains, and mosquitoes will breed there.

Old, disused wells in gardens are frequent sources of mosquito supply, even where apparently carefully covered, and here the nuisance is easily abated by the occasional application of kerosene. The same thing may be said of cesspools. Cesspools are frequently covered with stone and cement, but the slightest break in the cement, the slightest crack, will allow the entrance of these minute insects, and unlimited breeding often goes on in these pools without a suspicion of the cause of the abundance of mosquitoes in the neighborhood.

Fountains and ornamental ponds are frequent breeding places, and here the introduction of fish, as indicated in another place, is usually all-sufficient. It frequently happens, however, that the grass is allowed to grow down into the edges of ornamental ponds and mosquito larvæ find refuge among the vegetation and so escape the fish. Broad-leaved water plants are also often grown in such ponds, and where these broad leaves lie flat on the surface of the water, as they frequently do, one portion of a given leaf may be submerged so that mosquito larvæ may breed freely in the water above the submerged portion of the leaf, protected from the fish by the leaf itself, the fish rising from below. It is necessary, therefore, to keep the edges of such ornamental ponds free from vegetation, and to choose aquatic plants whose growth will not permit of mosquito-larvæ protection.

In these latter localities not only the house mosquitoes, previously mentioned, or the rain-water barrel mosquitoes will be found, but also some of the other forms, and particularly the malaria-breeding mosquitoes of the genus Anopheles. Some of these breed in all sorts of water accumulations.

In many small country towns, even where there is a water supply, tanks are to be found under the roofs to supply bathrooms. Such tanks should be screened, since mosquitoes gain entrance to the tank room, either through dormer windows or by flying up through the house from below, in search of places to lay their eggs.

About a large old house or a public building there are so many of these chance breeding places that only the most careful and long-continued search will find them all. As an example, in a State hospital, after a search which lasted for many days, and after a treatment of all possible breeding places found, mosquitoes still continued to annoy the patients. Finally in the darkest part of a disused cellar was found a half-barrel with standing water in it, which was giving out mosquitoes at the rate of hundreds per day. Frequent change of water or the use of kerosene will render all such breeding places harmless.

In community work in cities all of the points mentioned must be borne in mind, and in the portions of the community where the residences are for the most part villas, in the absence of swampy suburbs the householders are in the main responsible for their own mosquitoes. There are, however, breeding places for which the municipality may be said to be responsible, and these entirely aside from public fountains, reservoirs, or marshes. Roadside open gutters or ditches may breed a generation of any one of several species of mosquitoes, including malarial mosquitoes. On a pasture or common, where sod has been removed, water accumulating in the excavation thus formed may breed a generation of malarial mosquitoes. All such accidental breeding places should be abolished by filling in.

It seems unlikely that in any general sewage system mosquitoes may breed in the sewers proper. That they do breed in the catch basins is well known. The purpose of the catch basin is to catch and retain by sedimentation sand and refuse which would otherwise enter the sewer and deposit in it. It is intended to be water-tight and to hold a considerable body of water, which stands in it up to the level of the outlet pipe. Such catch basins are very commonly used in back yards and at the crossings of streets. The water is removed only by rain or when the street or yard surfaces are washed. In dry seasons the period of stagnation may last several weeks, certainly long enough for mosquito breeding. As a matter of fact, mosquitoes in midsummer do breed in such traps or catch basins by millions. These basins may be treated with fuel oil, or the municipal authorities may flush them once a week, carrying away such larvæ as may have hatched. The oiling of such places, however, is best.

Public dumps are great breeding places, because here accumulate old bottles, cans, boxes, bits of tin or iron vessels, and other objects in which water may accumulate for a time. Even a very small quantity of water will make a breeding place for very many mosquitoes. It is quite possible for a half of a bottle to contain enough water to give out literally thousands of mosquitoes. The writers know of one instance where a veritable plague of mosquitoes was traced to a case of empty bottles allowed to remain in a back yard for some weeks in midsummer. It is of great importance to have unburnable refuse from villages and cities dumped in definite places, and the dumps properly cared for. It is usually possible to find a hollow in a convenient location where the dumping may be done systematically and where the unsightliness of the débris as well as the danger of mosquito breeding may be avoided at reasonable expense by keeping the freshly dumped material covered with earth.

Search carefully for all such places, and destroy their suitability as mosquito-breeding places by carting away chance receptacles, by turning over vessels, by filling in excavations, or by treating other receptacles with a film of kerosene, or by introducing fish into fountains and artificial pools.

There is a possibility that under certain circumstances mosquitoes may breed in water accumulating in the troughs of underground-conduit electric railways. There is abundant opportunity for water to accumulate in these troughs, but no exact observations upon mosquito breeding in such situations have been made.

DRAINAGE MEASURES

Drainage measures really form a part of the consideration of the treatment of breeding places. The drainage of swamp areas for agricultural or industrial reasons needs no argument. The value of reclaimed swamp land for various purposes is well known. The drainage of swamp areas primarily in order to improve sanitary conditions and to reduce the scourge of mosquitoes, which in itself often prevents the proper development of near-by regions, is in operation and needs no argument. Drainage on a small scale for the purpose of doing away with mosquitoes has been practiced for a long time, and in many parts of the country large-scale drainage with mosquito abolition in view is going on, notably in New Jersey and in California. Methods of draining can not be entered into in this bulletin, but it should be pointed out that in case of salt-marsh land the operation is inexpensive, and results of great value have been reached both in California and in New Jersey.

Where the abolition of mosquito-breeding places demands extensive drainage, it is most effective and economical to employ a drainage engineer to map out the entire program before the work is actually begun. The kind of ditching equipment to be used will be governed largely by the conditions prevailing. New Jersey and California have had extensive experience with ditching apparatus.

DESTRUCTION OF LARVÆ BY TREATMENT OF BREEDING PLACES

While it is obviously best to abolish breeding places in the ways mentioned, it often happens that it is not possible to drain, and at least as a temporary expedient it becomes desirable to treat the water so as to kill the mosquito larvæ. Many substances have been tried, and, aside from certain proprietary mixtures, nothing has given such good results as the use of oils. Efforts to find oils that can be used to better advantage than petroleum have failed. Because of its general availability and low cost ordinary low-grade kerosene is very satisfactory. For extensive oiling operations, however, one of the petroleum distillate fuel oils, known also as gas oils, is preferable to kerosene.

In choosing the grade of oil two factors are to be considered: (1) It should spread rapidly; (2) it should not evaporate too quickly. The heavier grades of oil will not spread readily over the surface of the water, but will cling together in spots and the coating will be unnecessarily thick. The rapidity of spread of the film is also important. As to quantity, under still conditions, an ounce of kerosene to 15 square feet of surface space is about the right proportion, and in the absence of wind such a film will remain persistent for 10 days or slightly longer. Even after the iridescent scum apparently disappears there is still an odor of kerosene about the water. In a wind the film of kerosene is frequently blown to one side, but with a change will go back again, so the larvæ are destroyed. Not only are larvæ and pupæ destroyed by the kerosene film, but many adult mosquitoes alighting on the surface of the water to drink or to lay their eggs are killed by it. In California, H. J. Quayle has used a combination of heavy oil of 18° gravity and a light oil of 34° gravity, in the proportion of 4 to 1, respectively. This mixture made an oil that was just thin enough to spray well from an ordinary spray nozzle and yet was thick enough to withstand rapid evaporation. It was applied by a barrel pump where this could be used, and by an ordinary knapsack pump in other regions. A single application was found by Mr. Quayle to be effective sometimes up to four weeks. The army of occupation in Cuba used oil every two weeks.

In New Jersey much experimental work has been done with various larvicides. The authorities in charge of antimosquito work in that State have found very satisfactory distillate fuel oils of a specific gravity ranging between 28° and 38° Baumé with a minimum flash point of 150° F. J. M. Ginsburg, of the New Jersey Experiment Station, has also found that the addition of 1 gallon of crude cresylic acid containing 95 per cent of tar acids to 100 gallons of fuel oil increases the spreading of the oil on both salt and fresh waters covered with dead organic matter and vegetation.

There is some objection to the use of the colored petroleum oils and to kerosene on small ornamental pools on account of the discoloration effected by such oils and their adverse effects on plants. Where it does not seem feasible to utilize fish in such pools, the mosquito larvæ will be destroyed by covering the surface with a film of gasoline, but the effect of this treatment is of short duration.

The use of a spray pump has been mentioned. Small ponds can be sprinkled out of an ordinary watering pot with a rose nozzle, or for that matter pouring it out of a dipper or cup will be satisfactory. In larger ponds pumps with a straight nozzle may be used. A straight stream will sink and then rise and spread until the whole surface of the pond can be covered without waste. The English workers in Africa advise mopping the kerosene upon the surface of the water by means of cloths tied to the end of a long stick and saturated with kerosene.

In Panama a larvicide is being used which is made as follows: 150 gallons of carbolic acid is heated in a tank to a temperature of 212° F., then 150 pounds of powdered or finely broken resin is poured in. The mixture is kept at a temperature of 212°. Thirty pounds of caustic soda is then added and the solution is kept at the same temperature until a perfectly dark emulsion without sediment is formed. The mixture is thoroughly stirred from the time the resin is used until the end. One part of this emulsion to 10.000 parts of water is said to kill Anopheles larvæ in less than half an hour, while 1 part to 5,000 parts of water will kill them in from 5 to 10 minutes. At a larvicide plant at Ancon 4,600 gallons of this mixture was made at a cost of $0.1416 per gallon. Although this mixture has been used to a large extent in Panama, crude oil was also used for streams having a fair velocity.

It has been found that Paris green mixed with fine dust and blown as a powder over the surface of water will kill the top-feeding larvæ of the mosquitoes of the genus Anopheles. In antimalaria operations this method has come into use in many parts of the world. Paris green is mixed with road dust, fuller's earth, powdered soapstone, or something of the sort, in the proportion of 10 per cent by weight of Paris green. This dust may be distributed over breeding waters in many ways. On large areas of marsh the airplane has been found an expeditious and economical means. The cost of effective work at Quantico, Va., in 1927, under the joint auspices of the Public Health Service and the Medical Department of the Navy, was very slight, so far as the cost of material alone was concerned. The effective quantity of Paris green was found to be about 1 pound per acre of marsh. The cost of material was 72 cents per acre.

It has since been shown that Paris green may be used against mosquito larvæ that feed below the surface of the water if it is mixed with moist sand which drags it below the surface film.

THE LOCATION OF DWELLINGS IN RELATION TO MOSQUITO BREEDING PLACES

In the establishment of new town sites and of sites for camps the importance of choosing high, well-drained ground, well removed from mosquito-breeding areas, is obvious. Since most mosquitoes do not travel great distances,[5] especially in nonwooded areas, it is possible to reduce mosquito annoyance by a proper choice of such sites. The possibility of the application of this idea under rural conditions has been shown by studies carried out by W. V. King at Mound, La.

There is a common belief that mosquitoes breed in tall grass, shrubbery, and vines. This idea is erroneous, but such growth may hide water in which breeding may take place. It is well to keep in mind the fact that dense growths of vegetation give protection to mosquitoes and thus encourage them to stay in the vicinity of dwellings. Thus it is obvious that grass and weeds should be kept cut near habitations and dense growths of shrubs and vines avoided. In the South, where houses are not provided with basements, mosquitoes often hide beneath these dwellings. This condition can be remedied to some extent by spraying the supports and the woodwork beneath the floors with creosote oil, which not only preserves the wood but has a distinctly repellent effect on mosquitoes.

IMPOUNDING OF WATER TO CONTROL MOSQUITOES

The breeding of mosquitoes, especially of those species which carry malaria, is greatly favored by the presence, along the banks of streams, ponds, and bayous, of vegetative growths, shallow water, and irregular bank lines. In certain sections of the country the drainage depends upon the presence of an extensive system of sluggish streams and bayous. By raising the water level in such bayous by means of dams put in at proper places, it is possible greatly to reduce the opportunities for mosquito breeding. Such a plan increases the wave action, reduces the quantity of vegetation growing in the water, and enables top minnows and mosquito-feeding insects to carry on their work more effectually. The shelter along the banks of the streams is also reduced, thus giving less protection for the adult mosquitoes and decreasing egg laying.

THE RELATION BETWEEN LIVESTOCK AND MOSQUITOES AND MALARIA

In many parts of the country, especially along the coast where the salt-marsh mosquitoes breed, livestock are greatly annoyed by the attack of these insects. In fact, when swarms of mosquitoes become especially large the cattle which normally feed in the more or less wooded areas along the coast are so beset that their flesh condition and vitality are reduced, and they are ultimately driven into the open country, where the mosquitoes are less numerous. In irrigated areas in the West, as well as in inland swampy areas, livestock and poultry are often greatly annoyed by mosquitoes. No satisfactory method has been found of protecting livestock from mosquitoes. Well-constructed dairy barns may be screened so as to give some immunity from attack, and the use of kerosene-pyrethrum extract sprays will kill great numbers of the mosquitoes and have a slightly repellent action on others. Smudges have also been found to give a certain degree of protection to livestock, both in buildings and in pastures.

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[5] The salt-marsh mosquitoes are notable exceptions to this rule.

The fact that mosquitoes will feed upon various animals and poultry apparently has some protective effect for man. It has been observed frequently that where domestic animals are in close proximity to human beings they will feed upon the former and neglect the latter. It is possible that this may be a factor in reducing the incidence of malaria under certain conditions. The statement has been made that when malaria-infested mosquitoes feed repeatedly upon domestic animals they soon lose their ability to carry the disease.

THE PRACTICAL USE OF NATURAL ENEMIES OF MOSQUITOES

The common goldfish and silverfish destroy mosquito larvæ and should be put in artificial ponds. Top minnows of several species have been introduced successfully in several localities and are great feeders upon mosquito larvæ. Certain species introduced from Texas into Hawaii have been successful, and a small top minnow of the genus Girardinus, known in the Barbados as "millions," has been carried with success to others of the British West India Islands. In Rio de Janeiro another top minnow has been used by the public health service for placing in tanks and boxes where it was impossible to use petroleum. Top minnows are present in all parts of this country and are very useful in destroying mosquito larvæ. The effectiveness of these minnows may be increased by clearing the water of any vegetation or débris which will prevent the minnows from having free access to all parts.

There are many predatory aquatic insects that feed upon mosquito larvæ; others that catch the adults. Certain birds prey upon the adults, and bats also eat them, but the erection of bat roosts in the hope that this action will bring about an appreciable reduction in the mosquito population is not recommended by this department.

DETERRENT TREES AND PLANTS

A great deal has been published concerning the properties of certain growing plants which are said to keep away mosquitoes. Among these may be mentioned several species of Eucalyptus, the castor-oil plant, the Chinaberry tree, and others. Although the evidence in regard to these plants is contradictory, all observations made by scientific men in different parts of the world negative their value; claims that they are valuable are confined to people who have not made thoroughly scientific tests. Evidence is accumulating, however, that certain algæ of the genera Chara and Nitella will render water pools distasteful to mosquitoes.

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July 26, 1928

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FARMERS' BULLETIN No. 1571

The EUROPEAN STARLING IN THE UNITED STATES

THE EUROPEAN STARLING, now found as a breeding bird in many of the States east of the Mississippi River, apparently had its origin in this country in importations planted in Central Park, New York City, in 1890 and 1891. From this center its spread at first was slow, but since about 1910 it has been much more rapid. Not only are conditions in the upper Mississippi Valley well suited to the bird, but it seems likely that ultimately the species will be found also throughout most of the area from southern Canada to the Gulf coast and westward to the Rocky Mountains. Should the starling pass the Continental Divide there is no reason why it should not prosper on the Pacific coast also.

With such an extension of range possible, it is important that the economic influence of the starling be well understood. It is essential to know not only its misdeeds, so that proper methods of control may be evolved, but also its redeeming qualities, in order that the good services of the bird in insect control may be used to the best advantage. The harmful and the beneficial influences of the starling are weighed in this bulletin and conclusions drawn to aid both farmer and city dweller in adopting an intelligent attitude toward the species.

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THE EUROPEAN STARLING IN THE UNITED STATES

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THE STARLING AN INSECTIVOROUS BIRD

THE STARLING (*Sturnus vulgaris:* Family Sturnidae) is the second European bird to become widely established in this country. Its forerunner, the English sparrow, with its checkered career, has acquired a reputation far from praiseworthy. It is not surprising, therefore, that the ever-increasing flocks of starlings, which have been extending their range throughout the Eastern States, should be viewed with suspicion by farmers and bird lovers. The starling's aggressions against native hole-nesting species and its depredations on cherries, apples, corn, and garden truck, along with its objectionable roosting habits, have been cited as ample reasons for condemnation of the species. At first little was known by the public generally of its insect-eating habits, and it is only since the publication by the Department of Agriculture of a comprehensive technical report on the economic value of the bird that these facts have been definitely brought out.[1] The investigation on which that report was based was made in 1916 and not only refuted some of the extreme accusations against the bird but also established the fact that the starling is one of the most effective bird enemies of terrestrial insect pests in this country. More recently a similar investigation of the starling in Ontario, Canada, has resulted in conclusions essentially the same.[2]

This bulletin presents in condensed form the results of the earlier investigation, together with information on food habits subsequently obtained from stomach examination and field observation. Recommendations based on recent experiences with objectionable roosts of starlings also are included. The changes and additions bring the subject up to date and present the case of the starling as it is to-day.

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[1] KALMBACH, E. R., and I. N. GABRIELSON. ECONOMIC VALUE OF THE STARLING IN THE UNITED STATES. U. S. Dept. Agr. Bul. 868, 66 p., illus., 1921.

[2] LEWIS, HARRISON F. A DISTRIBUTIONAL AND ECONOMIC STUDY OF THE EUROPEAN STARLING IN ONTARIO. Univ. Ontario Studies, Biol. Ser. 30, 27 p., illus., 1927.

DISTRIBUTION AND ABUNDANCE

The starling in its native home occupies all but the most northern parts of Europe and corresponding latitudes in the western two-thirds of Siberia. Migration in fall takes the bulk of these birds to countries bordering on the Mediterranean, and a portion to the warm latitudes as far east as India. Several other species and closely related forms of starlings occupy adjacent sections and even parts of the same area in the southeastern portion of this range. The bird also has been introduced into other countries and has become established in Australia, Tasmania, New Zealand, and South Africa, and, since 1890, in Eastern United States, whence it has spread to southern Canada. Of the various attempts to introduce the starling into this country, the importations of 1890 and 1891 into Central Park, New York City, appear to be the ones from which the birds now scattered over the Eastern States and southern Canada originated.

The spread of the starling in this country has been by no means so rapid as that of its forerunner, the English sparrow. During the first six years after its importation it did not spread, as a breeder, beyond the limits of Greater New York. Since then, however, its progress has been more rapid. By 1900 it bred in western Connecticut and north-central New Jersey. By 1910 its breeding range included the greater part of Connecticut and Rhode Island, the southern part of Massachusetts, the lower Hudson River Valley, most of New Jersey, and a limited area in eastern Pennsylvania. In 1912 the range was farther extended up the valley of the Hudson, and since that time the bird has proceeded with greater rapidity. It crossed the Alleghenies in 1916 and by 1927 it bred regularly from southern Ontario and southeastern Michigan to Tennessee, northeastern Georgia, and South Carolina. The spread of the starling, as indicated by extensions of its breeding range by 2-year periods, is shown on the accompanying map. (Fig. 1.)

The wanderings of postbreeding flocks have carried starlings far beyond the limits of their breeding range, with the result that they may appear as winter visitors for several years before they are established as breeders. More detailed information concerning the distribution of this bird in the United States has been published in circulars of the department.[3] It would appear also from records thus far obtained from starlings banded near the border of the range of the species that these individuals have a tendency to migrate farther than those near the center of abundance and are the ones most instrumental in extending the range.

As a breeder the starling is by no means uniformly distributed throughout its range. It is decidedly partial to thickly settled agricultural sections and has also shown a preference for coastal regions and larger river valleys. Thus, in its spread over the country, it usually becomes established in lowlands first. In much of the area where the starling has been established for 15 or 20 years it probably has reached a maximum breeding abundance. This appeared to be true in 1916 in sections of New Jersey and Connecticut adjacent to New York City, where the starling about equaled the English sparrow as a breeder. In the residential sections of some of the cities the starling then outnumbered the English sparrow, but it in turn was greatly outnumbered by the smaller species about freight yards, markets, business streets, and dumping grounds, and even in many of the rural sections. Beyond areas of maximum abundance, the centers of starling population where the bird as much as equaled the English sparrow as a breeder were quite restricted and often isolated by many miles from other colonies. At the border line of its range there are vast areas where for years its abundance will not be great enough to make the bird an important economic factor.

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[3] COOKE, MAY THACHER. SPREAD OF THE EUROPEAN STARLING IN NORTH AMERICA. U. S. Dept. Agr. Circ. 336, 8 p., illus., 1925; and THE SPREAD OF THE EUROPEAN STARLING IN NORTH AMERICA (TO 1928), U. S. Dept. Agr. Circ. 40, 10 p., illus., 1928.

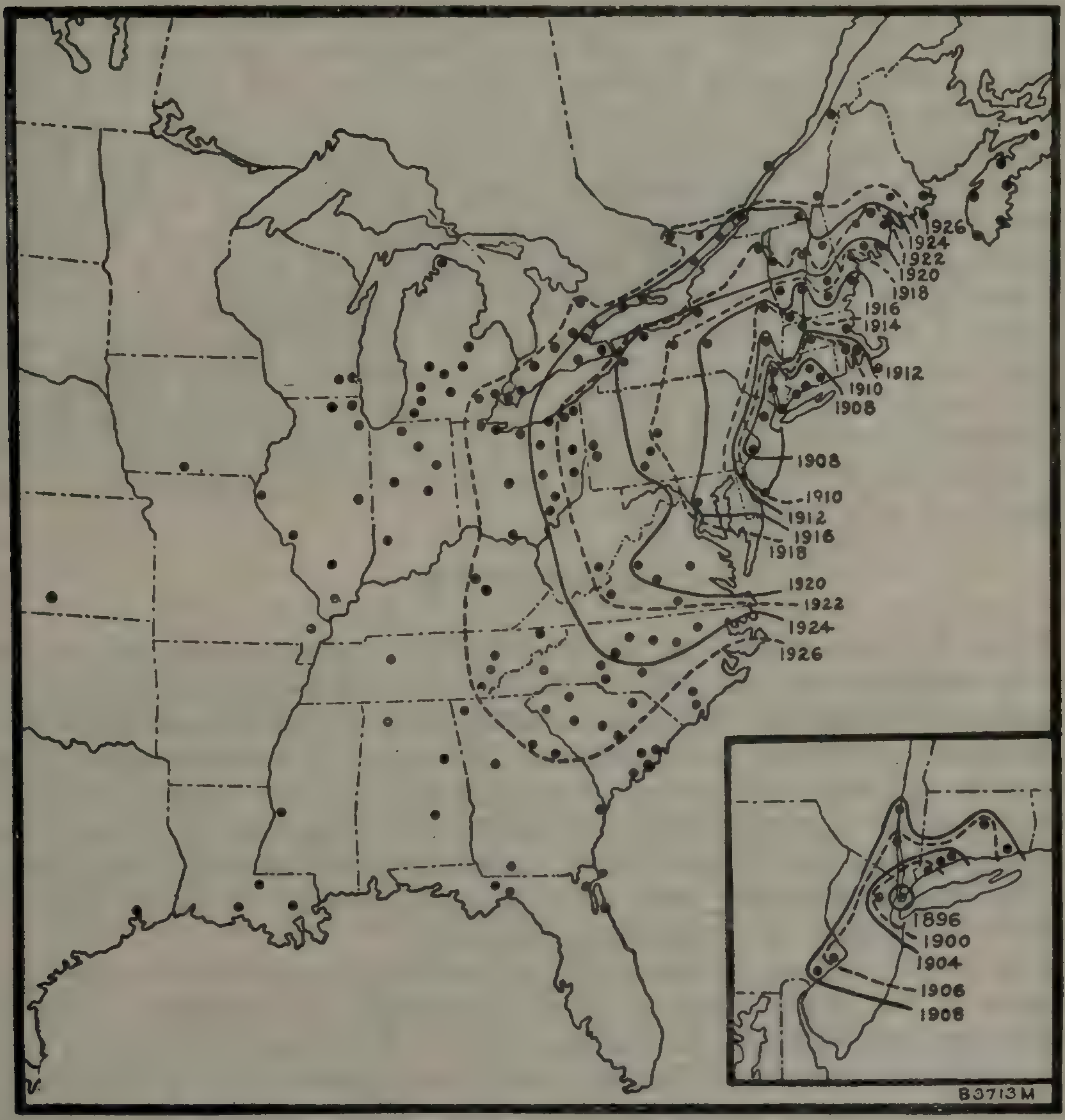

FIG. 1.—Breeding range of the starling in North America. Areas successively covered in 2-year periods are shown by alternating broken and continuous lines. Spots outside the line of the 1926 range indicate isolated records, mainly in winter

Although the severe winter of 1917–18 appeared to exert a check on the multiplication of the starling over much of its range, since that time the bird has more than recouped its former numbers. This increase has been particularly noticeable in the vicinities of Philadelphia, Baltimore, and Washington. The large winter roosts in cities also have brought to the attention of many persons, who otherwise would not have been aware of their presence, the many thousands of starlings in areas where only a decade previously there were comparatively few.

From the preferences shown by the starling as regards habitat and food, both in Europe and in this country, and from knowledge of the bird's ability to adapt itself to new environments some conjecture concerning its ultimate distribution in the United States may be ventured. Until 1916 the Allegheny Mountains appeared to be an effective barrier against westward progress, but now that large numbers are to be found in the watershed of the Ohio River, the spread throughout the fertile farmlands of the upper Mississippi Valley should be rapid. The starling should experience little difficulty in extending its breeding range as far north as northern Michigan, Wisconsin, and Minnesota. To the south the bird will probably go nearly to, if not actually as far as, the Gulf coast as a breeder, though it may always be scarce in the southern part of this area, particularly on the coastal plain. To the west, the Great Plains, with their scarcity of suitable nesting sites, and back of them the Rocky Mountains with their high altitudes, will probably bar the starling for some time from reaching the Great Basin or California by either a northern or a southern route.

DESCRIPTION

Even in areas where the starling has been long established uncertainty exists as to its identification. Post-breeding flocks of red-winged blackbirds are sometimes called starlings, and the damage they do is often attributed to the latter. The great difference existing between the plumages of young and adult starlings, as well as the great change in the appearance of the old birds from fall to spring, also leads to confusion. The starling, however, bears several conspicuous marks of identification, and when these are borne in mind, one will have little trouble in recognizing the bird.

The adult starling is about 8½ inches long and of about the same weight as the robin, but its short, drooping tail gives it, when at rest, a chunky, hump-backed appearance. From early in spring until the middle of June the adult bird may be singled out at a distance as the only black bird having a rather long, sharp, yellow bill. In the male the base of the lower mandible is somewhat darkened with livid, while in the female this part is pale yellow. After the breeding season and coincident with the molt the entire bill darkens until it is nearly black, a color it retains through the period of sexual inactivity. In some instances, the brightening of the bill may occur as early as the middle of November, though normally it is not apparent until January or February.

The molt is usually completed by the middle of September and leaves the starling a much-changed bird. Each of the feathers of the sides of the head, breast, flanks, and underparts has a white tip, giving the bird a gray, mottled aspect when seen from a distance.

At close range, however, this is a handsome plumage; the dark parts of the feathers of the throat, breast, and flanks are resplendent with iridescent reflections of purple, green, and blue, while the back, with its green and bronze iridescence, has each of the feathers tipped with light brown; the tail and wings are dark, some of the feathers of the wings being edged with brown. During the winter most of the white tips to the feathers on the breast and underparts wear off, leaving the bird dark below with the iridescent reflections still present.

When the young leave the nest they are a uniform dark olive-brown on the back. Below they are at first somewhat streaked with lighter markings, but soon become unicolored. The throat is white or buffy. The first molt begins about the same time as that of the adults. The feathers on the sides of the breast, the flanks, and center of the back are changed first, those of the head being the last replaced. During July and August and early in September young birds in all stages of the molt may be found. When the plumage has been completely changed the young can not with certainty be distinguished from the adults, although they tend to have larger white tips to the under feathers.

In flight also starlings may be confused with a few other birds. From other gregarious species with which they often associate starlings may be distinguished by the wonderful coordination of action between the individuals of the flock, their rapid wing beats, great speed, and ability to alter direction instantly. From their habit of sailing on fixed wings for considerable distances they are often mistaken for purple martins, but a little watching will reveal the difference in the speed of the two species.

In searching for food the starling walks rather rapidly and with little change of pace, keeping up a continuous zigzag course when on grassland, seldom hesitating unless to pick up food or to probe beneath the surface.

Many bird lovers contend that the starling's lack of song is a good reason for not allowing it to supplant more accomplished native songsters. Although its notes, except for a clear whistle or two and a coarse rasping note of alarm, are subdued and lacking in melody, should one chance to be close to a male starling when he is putting forth his best efforts the result will be found fully as fascinating as the more celebrated whisper-songs of the catbird or brown thrasher. The starling is a mimic par excellence and has the notes of a number of our native birds in his repertoire. One of the birds frequently imitated is the wood pewee, whose plaintive "pee-a-wee" is reproduced with such delicate skill that it can not be distinguished from the song of the woodland flycatcher itself. The mellow tones of the bluebird's call are given with almost equal fineness. In areas where the bobwhite is common its two-noted whistle is readily taken up by the starling and executed in a way that closely resembles the original. Notes of the red-winged blackbird, grackle, field sparrow, flicker, blue jay, Carolina wren, and English sparrow, as well as others, also are given. Young starlings have a harsh hissing or rasping note that seems to have its origin as a feeding call but is given for some time after they leave the nest.

LIFE HISTORY

By the middle of April most of the starlings have paired and started breeding operations. Although a hole-nesting species, they are less particular in choice of nest sites and in nest construction than are most native birds that build in cavities. In their nesting operations starlings will appropriate either old or newly excavated woodpecker holes and natural cavities in trees, as well as boxes erected for native species. (Fig. 2.) They are partial to human association and may be found nesting also in almost any sort of cavity about buildings, behind window shutters, on fire escapes, and even in open boxes erected for domestic pigeons. When in trees, starling nests as a rule are at a height varying from 10 to 25 feet from the ground.

The nest itself usually is constructed of dry grasses, but straw, corn husks, string, and cloth are materials utilized occasionally. A little green foliage, such as may be plucked from a near-by branch, is frequently dispersed through the structure, and the interior, approximately 3 inches in diameter, is lined with a few chicken feathers. (Fig. 2.)

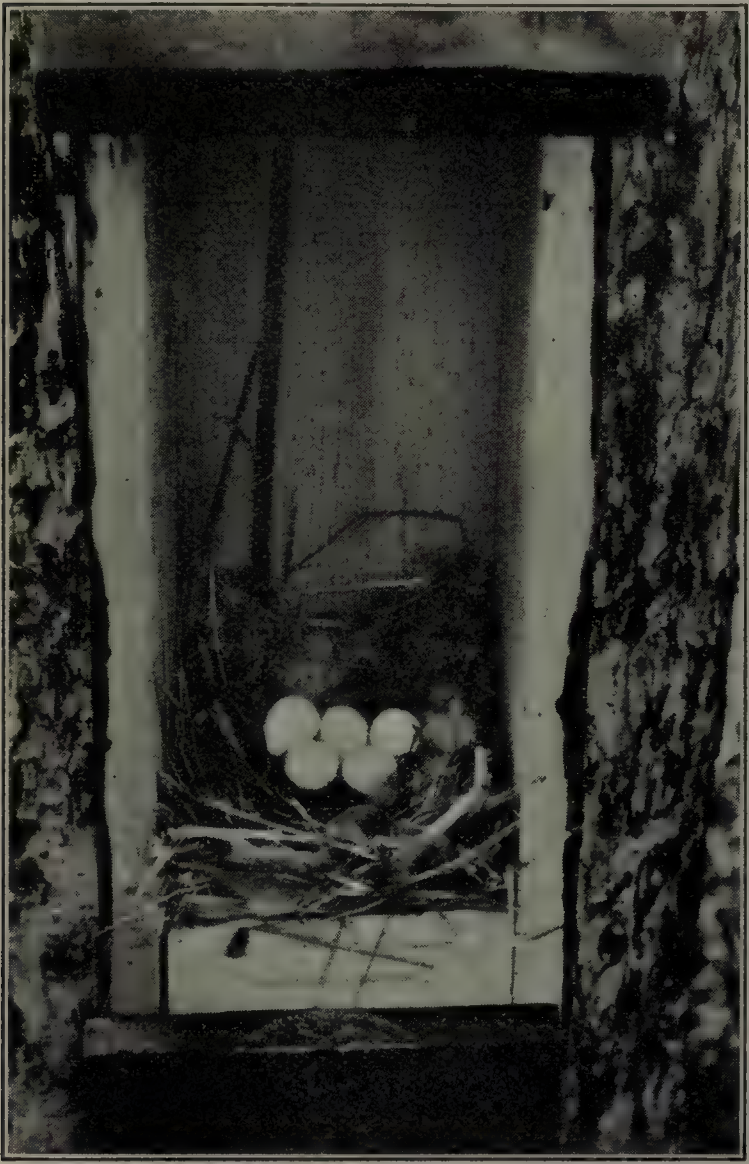
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FIG. 2.—For nesting sites starlings will appropriate either old or newly excavated woodpecker holes, natural cavities in trees, boxes erected for native species, and almost any sort of a cavity about buildings. The front of this bird box has been removed, showing a starling's nest and the eggs, which are pale blue

The eggs are pale blue and number from three to six to the set. Incubation lasts about 12 days, and the young remain in the nest for two or three weeks. Two broods are raised each year by many pairs and rarely a third is hatched. The first brood leaves the nest about June 1 and the second late in July. Soon after the first brood leaves, the young gather in flocks, which grow rapidly in size, and late in August and early in September flocks numbering into the thousands may be seen in sections where the starling is a common breeder. There is practically no daytime association between the juvenile birds and the adults from soon after the time the former leave the nest until the molt is completed late in September. At night, however, in summer and fall both old and young birds may be found occupying the same roost. (Fig. 3.)

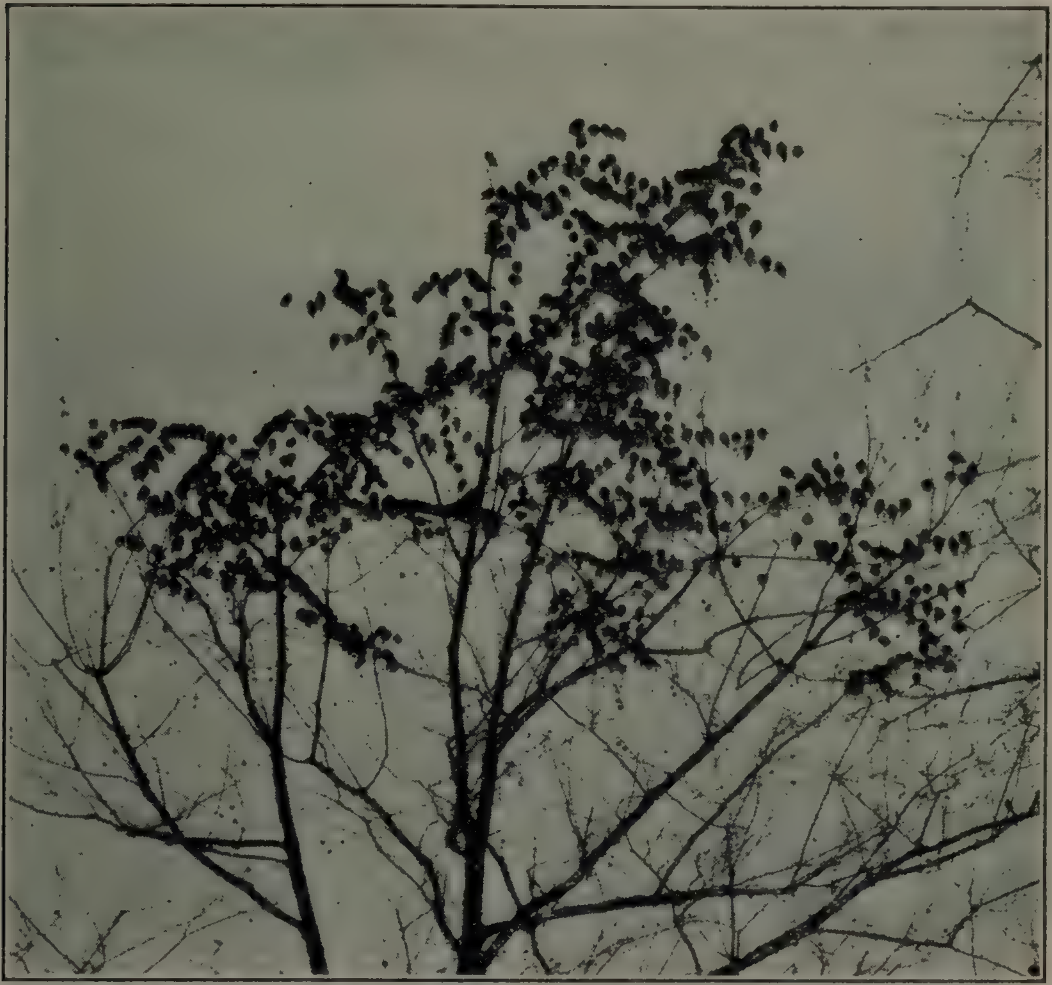

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FIG. 3.—Late in summer and during fall starlings commonly resort to tree roosts, often being joined by grackles, robins, and even purple martins. In latitudes as far south as Washington, D. C., a portion of the starlings use trees as roosting spots even in the coldest weather. Photograph taken before sunrise

To the city dweller the establishment of these roosts is the most conspicuous habit of the starling. Strange to say, the arching elms and maples of quiet residential sections of cities are places particularly attractive to these birds, and such localities are often selected, even though tracts of woodland, presenting apparently equally favorable roosting places, may be near by. Frequently the roosts are shared with other species, particularly grackles and robins. The noise produced by the gathering birds in the evening and their daybreak serenade, as well as the filth connected with thousands of birds confined to a small area, make the roosts decidedly objectionable. At the advent of cold weather in October or November, the tree roosts of starlings become smaller as more and more of the birds seek nightly shelter in church towers, barn cupolas, pigeon lofts, ledges beneath eaves of buildings, ventilators, or other protected places.

The winter roosts of starlings in eastern cities are sometimes of enormous size. Typical of such gatherings is the one that for several years has occupied the trees and buildings on Pennsylvania Avenue and other down-town streets in the National Capital. For a distance of several blocks along Washington's historic thoroughfare starlings gather nightly during the fall and winter months in flocks totaling tens of thousands. Buildings with broad, sheltering eaves often have protected ledges and window sills outlined with rows of black-bodied starlings (fig. 4); and the capitals of columns at the entrances of some of the public buildings have been given similar adornment. Individual trees near the center of the roost area also furnished roosting places for more than a thousand birds, and ventilators on tall buildings harbored several thousands under conditions that assured the birds protection from rain and cold as well. Outside of the roost proper scattering flocks found nightly haven on other buildings in the business center of Washington, and at more distant points church towers afforded a readily accessible and suitable resort.

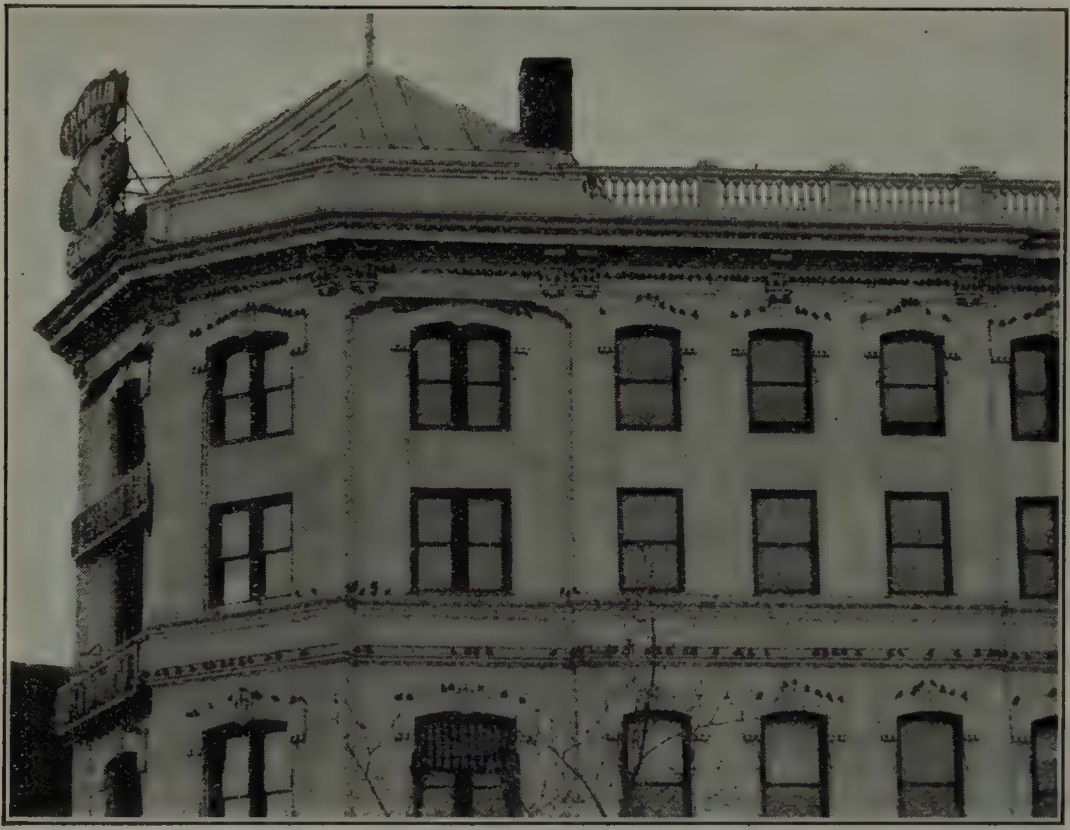
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FIG. 4.—When roosting on the sides of buildings during winter, starlings seek the ledges that are best protected from rain and snow. They also tend to frequent the sides that have been exposed to the warming rays of sunlight during the day. Photograph taken after sundown

One such church tower harbored on cold nights of midwinter from 2,500 to 3,000 starlings. Though the tower was not heated, the birds were able to keep surprisingly warm by crowding into small crevices in great numbers. As many as 80 to 100 starlings were found in cavities 2 feet wide, 3 feet deep, and a few inches high. So densely was this tower populated that there was no difficulty in capturing, banding, and releasing in two and one-half hours 1,000 birds for a study of their migratory movements.

Besides the gregarious habit, which tends to bring together late in summer and early in fall the breeding starling population of a considerable area, a migratory movement has been manifested. This, however, is not so pronounced as that practiced by the bird in the Old World. In this country starlings have shown a preference in winter for the coastal regions of Connecticut, New York, and New Jersey, and a general southward movement also has been observed at that season. At Washington, D. C., and at points even farther south, starlings had established winter roosts for several years before the first breeding birds made their appearance. The migratory instinct may become more pronounced after the birds are more generally distributed and familiar with conditions in the warmer Southern States.

FOOD HABITS IN THE UNITED STATES

Information regarding the food habits of the starling in this country has been obtained largely from analysis of a mass of material apparently greater than that used for a similar study of any other bird. A total of 2,626 stomachs of starlings, collected mainly in 1916 in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and Delaware, served as the basis for an intensive study of the economic status of this bird.[4] Percentages of food items presented in this bulletin have been incorporated largely from the earlier study. Since that time, however, 124 additional stomachs, obtained in Atlantic Coast States, have been examined, and notes from this material also have been included. Extensive field observations, particularly those made by representatives of the Bureau of Biological Survey during a period of six and a half months of the growing season of 1916, have given first-hand information on phases of the bird's habits not satisfactorily revealed by stomach examination. Notes on the habits of the starling contributed by various correspondents also have aided in determining the bird's economic status.

ANIMAL FOOD OF ADULTS

More than half (57 per cent) of the annual food of the adult starling consists of animal matter, including insects, millipeds, spiders, mollusks, a few crustaceans, and bits of suet and carrion. In April and May such food constitutes more than nine-tenths of the bird's diet, and even in February, when the opportunities for obtaining animal food are few, it forms more than 28 per cent of the total.

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[4] A comprehensive report on this material appeared in Department Bulletin 868 (see footnote 1, p. 1); 102 of the stomachs examined were collected in 1910 and reported on by E. H. Forbush (THE STARLING. Mass. State Bd. Agr. Circ. 45, 23 p. illus., 1915).

INSECTS

Nearly three-fourths of the animal food of the starling, or more than 42 per cent of its entire diet, consists of insects. October is the month of greatest consumption of insects, when they form nearly 58 per cent of the food, but in June, August, September, and November they also provide more than half of the starling's sustenance. From the first of December to the end of March insects furnish about a fourth of the bird's food, a rather remarkable proportion when the climatic conditions under which the insects are captured are considered.

Nearly half the starling's insect food consists of beetles—weevils, ground beetles, and plant-feeding scarabaeids predominating. Conspicuous among such items is the clover-leaf weevil (*Hypera punctata*), a European pest imported into the Eastern States some years ago and now reported as doing damage as far west as California and Oregon. The starling has displayed a remarkable ability in finding these insects even under adverse conditions of climate and environment. Nearly half of the adult starlings examined had fed on them. One bird had eaten 49 larvae of this insect and another 26 adults along with 6 other weevils. The lesser clover-leaf weevil (*Phytonomus nigrirostris*) and the clover-root curculio (*Sitona hispidulus*) are other pests that the starling frequently obtains in meadow and hayfield. Among the ground beetles eaten by the starling, those forms known to have certain vegetarian food habits occur most frequently.[5] As many as 37 individuals of species having marked herbivorous habits were found in one stomach. Of the large predacious carabids (Calosoma and Carabus) known to be effective enemies of caterpillars, starlings eat few, only 23 adult birds having fed on them. Of the plant-feeding scarabaeids, May beetles (Phyllophaga), parents of the destructive white grubs, predominate in the food, as many as 12 being found in one stomach. In areas where the Japanese beetle (*Popillia japonica*) has become established the starling has been quick to detect its presence and must be classed as one of the most effective bird enemies of that pest. Fourteen of twenty-three starlings collected near Riverton, N. J., in 1920 had fed on Japanese beetles, in some instances nearly all of the birds' food being derived from this source. The smaller dung-inhabiting species (Aphodius and Ataenius) also are obtained in considerable numbers when starlings are feeding in the vicinity of cattle. Of the other beetles eaten by the starling click beetles (Elateridae), parents of wireworms, and leaf beetles (Chrysomelidae), among which was the notorious Colorado potato beetle (*Leptinotarsa decemlineata*), found in 24 stomachs of adults, are the ones most worthy of mention.

Grasshoppers, long-horned grasshoppers, and crickets furnish about an eighth of the yearly food of the adult starling. From August to November these insects form the bulk of the animal matter taken, and 577 of the 772 birds collected during this period had eaten them. In October nearly 39 per cent of the starling's diet comes from this source. When hayfields are being cut and raked in the latter part of August and early in September flocks of young starlings obtain practically all of their sustenance from these insects, supplementing it with wild black cherries and elderberries. Individual stomachs frequently contained surprisingly large numbers of these insects. One juvenile bird had eaten 7 short-horned grasshoppers (Acrididae), 1 field cricket (Gryllus), and no less than 47 small striped ground crickets (Nemobius); another had taken 5 grasshoppers, 2 field crickets, and 47 ground crickets; and a third, 6 grasshoppers, 1 long-horned grasshopper (Xiphidium), 1 field cricket, and 42 ground crickets. Conspicuous among the grasshoppers eaten were the red-legged locust (*Melanoplus femur-rubrum*) and others of the same genus.

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[5] Especially members of the genera Harpalus and Anisodactylus.

Lepidopterous remains in the food of the starling are comprised almost entirely of the larvae (caterpillars). In the stomachs of adults these insects constituted 6.04 per cent of the yearly food, the greatest numbers being consumed in May and June. Conspicuous among those birds that had fed extensively on caterpillars was a series of 31 adults collected in the middle of June near Flemington, N. J. Only one had failed to eat caterpillars, which, on the average, formed 27.8 per cent of the stomach contents. In point of numbers eaten, a starling collected at New Haven, Conn., takes the honors; in this bird's stomach were the remains of 40 caterpillars, forming 98 per cent of the food. The terrestrial feeding habits of the starling limit the variety of caterpillars eaten, but this restriction has permitted the bird to distinguish itself as a most effective enemy of that notorious pest, the cutworm. In only a few instances were hairy or spiny caterpillars found in the stomachs. The European corn borer also has not been overlooked by the starling. A single bird collected at Watertown, Mass., had fed on six of the borers.

Hymenopterous remains, including bees, wasps, and ants, formed less than 2 per cent of the adult starling's food. Although some of these insects were beneficial parasitic forms, by far the greater part consisted of ants. Connected with the capture of the winged forms of the latter insects is one of the oddest activities of the starling: Although primarily terrestrial feeders, young starlings may be seen soon after the first of August darting forth from upper branches of trees and catching insects on the wing, much after the fashion of true flycatchers. Still later in the year starlings change their tactics of obtaining flying insects, and capture them while circling high above the ground much after the fashion of martins or other swallows. At such times one not acquainted with starlings is likely to mistake them for martins, for now in addition to being very similar in form, the starling's flight evolutions imitate the martin's perfectly.

No other order of insects forms as much as 1 per cent of the adult starling's yearly food, and the economic problems involved in their consumption are trivial. Among these are both predacious and plant-feeding bugs (Hemiptera) and flies (Diptera) and their larvae. Many of the latter are obtained about garbage heaps and in the neighborhood of cattle, of which starlings are familiar associates. These birds have been seen picking flies from the legs of cattle, and in a few instances actually alighting on the backs of cows, with the apparent intent of catching the insects there also.

From the viewpoint of the farmer the insect-feeding habits of the starling leave little to be desired. In its diet are some of the worst pests of garden and field. These it takes in surprisingly large quantities during the growing season, and even in winter it eats many hibernating individuals. Its partiality for the vicinity of human abodes means that a great part of its beneficial work is done in the garden, where it will result in direct benefit.

MILLIPEDS

As far as known, no other species of bird in this country eats as many millipeds as does the starling. These creatures form 11.71 per cent of the adult bird's yearly diet, and in April they supply more than half the food (54.69 per cent).

At present the economic status of millipeds in this country is not fully understood, but if the idea generally entertained a few years ago be accepted, that millipeds feed entirely on decaying vegetable matter, the starling's fondness for them would have to be construed as a neutral factor in judging the bird. In England, however, millipeds of the same and closely related genera are known to be decidedly destructive in gardens, and recent investigations in this country have revealed instances of their displaying similar habits. Nevertheless, whether the millipeds are neutral or injurious, in feeding on them the starling obtains animal food without drawing materially from the supply of other birds, few of which have shown a preference for millipeds.

SPIDERS, SNAILS, AND OTHER MISCELLANEOUS ANIMAL FOOD

Most of the spiders eaten by the starlings are the rapidly running wolf spiders (Lycosidae), which are terrestrial in habits and generally considered less distinctly beneficial than some of the others that secure many of the flying insect pests in their silken nets. Of snails the starling eats few in this country, a habit in sharp contrast with its actions in England, where it is recognized as an effective enemy of land slugs, so injurious to garden plants.

The remains of earthworms, fragments of a crab, a few beach fleas, sow bugs, and bits of fat, suet, or cartilage, obtained apparently from garbage dumps or the winter feeding stations erected by bird lovers, fill out the varied animal diet of the starling.

VEGETABLE FOOD OF ADULTS

CULTIVATED CHERRIES

The starling's raids on the cherry crop are the basis of the most frequent complaint against the bird and at present result in the greatest losses occasioned by it. Cultivated cherries form 2.66 per cent of the adult starling's annual diet, but, of course, the consumption of such food is restricted to June and July, when it forms approximately 17 and 15 per cent, respectively. About a third of the birds collected in June and about a fourth of those in July had fed on cherries.

Some idea of the extent of the starling's activities may be gained by comparison with the food habits of the robin. From the examination of 1,236 stomachs, it has been found that the robin feeds on cultivated fruit about twice as much as does the starling, and during

June and July, robins obtain about 24 and 23 per cent, respectively, of their food from cultivated cherries.

In their attacks on the cherry crop, robins and starlings employ different methods. The robin is generally distributed and feeds in loose companies, individuals of which may be found maintaining an almost uninterrupted procession to and from some favorite cherry tree for entire days. At no time will a great number of birds be found in the tree, but the slow drain on the cherry crop is constant through all hours of daylight. Starlings, on the other hand, the juveniles of which are the chief offenders, often gather in large flocks and, swooping down on a single tree, completely strip this of its fruit, leaving other trees in the neighborhood entirely unmolested. Thus, practically every cherry grower complains of the robin; while those who suffer from the more spectacular raids of the starling are much more bitter in their criticism.

Starlings, however, are easily frightened and soon learn to shun areas where they are persecuted. A shot or two discharged at a flock of cherry-stealing starlings usually serves to keep the birds away for a few hours, and occasional shooting during the few days immediately preceding the ripening of the crop will save most of it from their attacks.

APPLES

Of a total of 2,301 adult starling stomachs examined, 45 contained the pulp or skin of apples. Only 22 of the 45, however, were among those collected in September and October, the remainder having been taken in winter and early in the spring, when the fruit eaten was manifestly waste, left on the trees or fallen to the ground. In bulk, apples form less than 2 per cent of the starling's diet. The fruit in old orchards and on isolated trees, especially on those standing in the middle of hayfields where flocks of juvenile birds are accustomed to feed, is likely to be damaged. Late-maturing varieties also are more frequently attacked by starlings than are those ripening at the height of the apple season, possibly because the supply of wild fruit, as wild black cherry (*Prunus serotina*) and sour gum (*Nyssa sylvatica*), has been materially depleted by that time.

As in the starling's feeding on cherries, it is the flocks of juvenile birds that are to blame for most of the damage to apples. The fruit in the central top of the tree is most often sampled, and in many instances the birds return to feed on fruit attacked on previous occasions. An opening an inch or two in diameter is pecked in the skin, and through this break a large portion of the pulp and sometimes the seeds are removed. (Fig. 5.)

Although much time and attention both in field observation and stomach examination were given to investigating the relation of the starling to the apple crop in 1916, the positive incriminating evidence against the bird was slight. On no farm given largely to fruit raising, where the trees were thrifty and well kept, was injury to apples observed or reported. A very large number of extensive fruit raisers in areas where starlings were abundant had no complaint to make against them. The bulk of the damage was confined to old orchards or isolated trees, usually in environments to which the starling is partial, and in many cases the damaged fruit was on neglected trees or those of inferior quality.

To a great extent this situation still prevails. Since 1916, however, the starling has extended its range and become abundant in important apple-growing sections, notably those in New York State and in the Shenandoah Valley of Virginia. What the ultimate result of excessive numbers of these birds will be in areas given largely to apple raising is uncertain. Judging from past experience, the extensive grower of apples has little to fear; yet the fact can not be evaded that excessive abundance of any bird that is frugivorous, even to a limited degree, may become a source of great damage. The starling will bear close watching in extensive apple-raising sections.

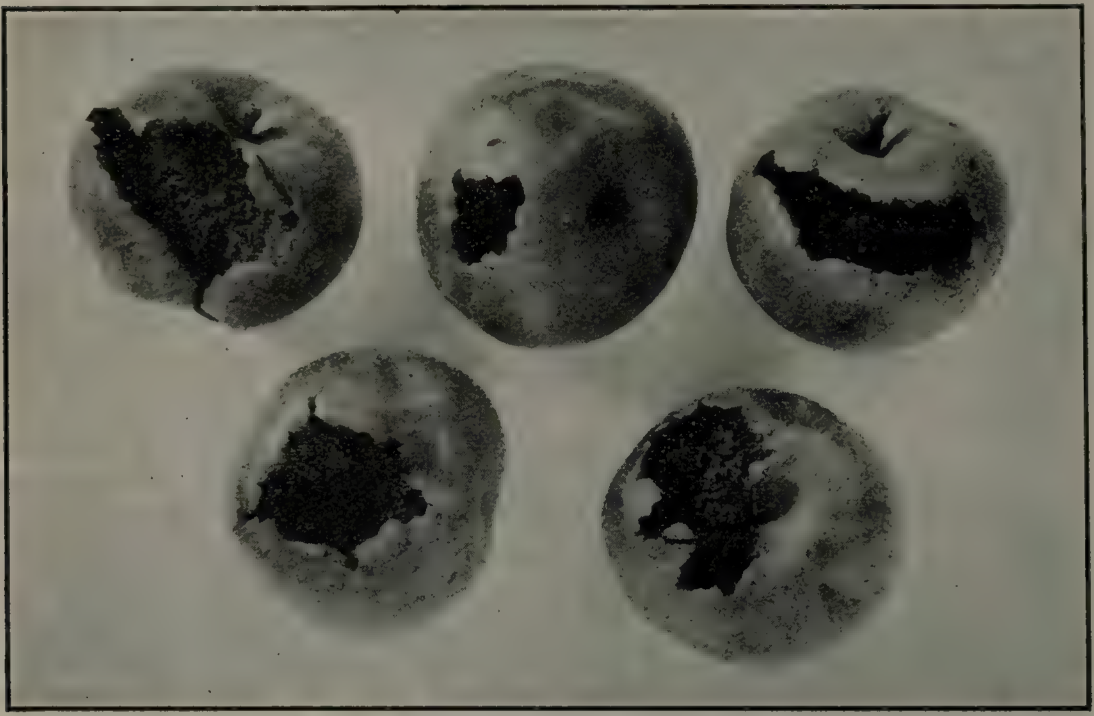

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FIG. 5.—Russet apples damaged by starlings. These apples were from the tops of trees in an old orchard near Adelphia, N. J. Some of the damaged fruit showed evidence that the birds returned to apples opened on previous visits

OTHER FRUITS

To a slight extent starlings inflict damage on peaches and pears. They also sample grapes, but at present the injury is confined principally to small arbors. In 1927 starlings inflicted severe damage to grapes on the Arlington (Va.) Experimental Farm of the Department of Agriculture. (Fig. 6.) A large flock driven from neighboring cornfields by bird minders congregated in the vicinity of the vineyard of 2¼ acres and in a few days destroyed almost the entire crop on some vines. By moving the bird minders to the vineyard the damage was stopped. In view of the reputation of the starling in the vineyards of France, also, its advent to grape-growing sections in this country should be watched. Strawberries, blackberries, and raspberries also are occasionally attacked, but the aggregate damage to fruits of this kind is negligible.

CORN

Probably the bird damage most keenly felt by the farmers living in the intensively cultivated areas in northeastern New Jersey is that inflicted by grain-eating species on sweet corn. During July and August mixed flocks, numbering into the thousands, of grackles, red-winged blackbirds, cowbirds, and, in recent years, starlings, roam through the country, obtaining the bulk of their sustenance from cornfields. Sweet corn, just ready for market, is torn open, some of the juicy kernels eaten, and the ear either rendered unsalable or its market value considerably reduced. In the aggregate such losses are very great, and the farmers of northeastern New Jersey hold the starling to blame for a large share of the damage. As in the case of men, however, who are often judged by the company they keep, the starling has been accused of deeds perpetrated largely by the species with which it associates. Not only is it generally accredited with eating as much corn as the grackle and the red-winged blackbird, an assumption that has been disproved, but many farmers confuse it with these species, with the result that flocks of juvenile redwings are often considered to be starlings and their depredations charged against the newcomer.

Of the total of 2,301 adult starling stomachs examined, 52 contained corn, which formed 0.77 of 1 per cent of the yearly food. Of the 1,059 starlings collected during the ripening and harvesting season of July, August, September, and October, only 14 had fed on corn. This constituted only 0.2 per cent of the sustenance of these birds during this period. In the planting and sprouting season of April and May, 6 out of 249 adult starlings had fed on corn, which formed 0.52 per cent of the food. By far the largest part of the corn eaten by starlings is waste grain obtained during winter and early spring.

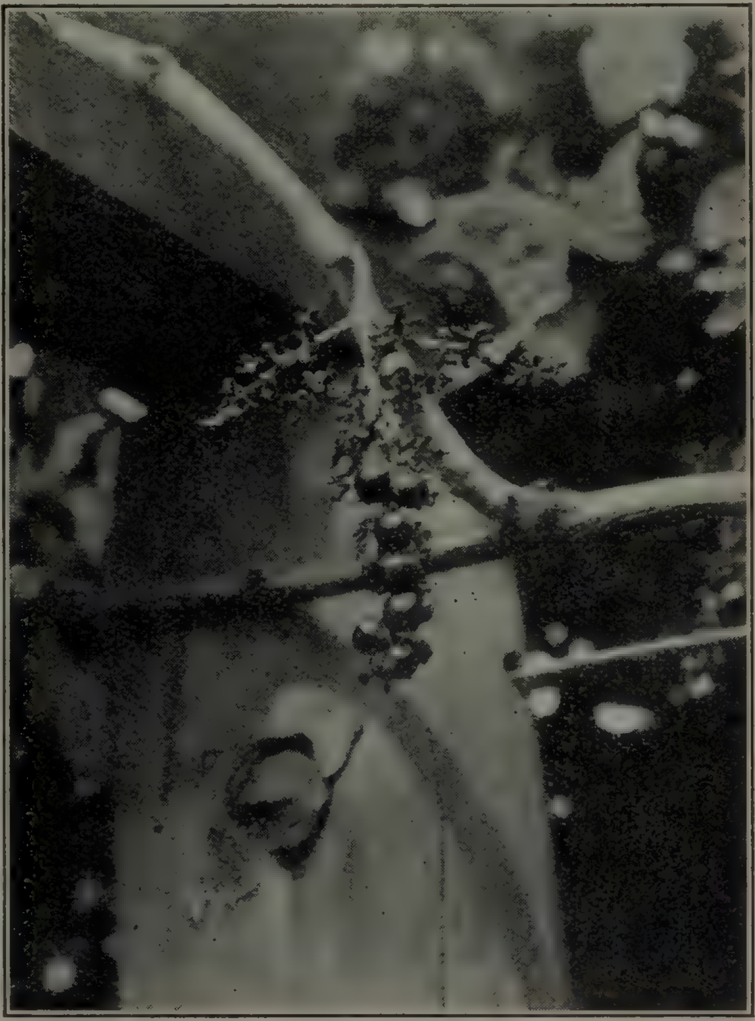

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FIG. 6.—Grapes on the Arlington (Va.) Experimental Farm of the Department of Agriculture severely damaged in 1927 by starlings, aided by catbirds and robins. A bird minder had to be stationed in the vineyard to put a stop to the depredations

The result of the examination of so large and thoroughly representative a series of stomachs tends to disprove the extreme charges against the starling as a corn eater. On a few occasions the writer observed starlings actually tearing down the husks of corn and feeding on the kernels, but in no case were they seen in large flocks inflicting serious damage. From other observers, however, positive incriminating testimony has come, and a few cases are on record where flocks consisting only of starlings have damaged fields of sweet corn to the extent of from 10 to 25 per cent of the yield.

Injury to field corn is noted less frequently, and many of the reports are subject to the same errors of identification of the birds doing the work. In the vicinity of roosts, however, field corn in the dough stage is likely to be damaged in the morning and evening when the starlings appear in flocks often numbering thousands. To a limited extent starlings are accused of pulling sprouting corn, but the aggregate damage is trivial.

In summarizing the relation of the starling to the corn crop it may be said that while the examination of a large and representative series of stomachs has shown that the bird is not an extensive feeder on corn, field observation has revealed that under certain favorable local conditions, as in the vicinity of roosts, the bird may do damage. The fact that starlings are easily frightened by gunfire, and will shun an area after a day or two of shooting, suggests effective preventive measures.

SMALL GRAIN

The farmer has little to fear from the starling as a menace to small grains. Only 20 of the 2,301 adult starlings examined had fed on small grain. Of these 13 had eaten wheat; 6, oats; and 1, millet. In bulk this formed 0.39 per cent of the food, and fully half this was eaten at a time of year when it manifestly must have been waste. The few complaints on this score were either so trivial or, when of consequence, were so few and widely separated that the aggregate injury can not be important.

GARDEN TRUCK

The starling's depredations in the garden include injury to ripening tomatoes, lettuce, onions, peas, beans, and sprouting muskmelons; and in one truck-crop section, where seeds of radishes, parsley, and spinach were planted under manure early in the year, starlings were accused of scratching them out. In the main their work is confined to small plots, and the losses are most keenly felt by the city dweller who has painstakingly tilled a few square yards of soil to raise produce for home consumption. In extensive truck-crop sections the aggregate damage of this kind is not great.

WILD FRUIT

Wild fruit forms an important food item for the starling, supplying more than 22 per cent of its yearly sustenance, and in August, when large quantities of wild black cherries (*Prunus serotina*) and elderberries (*Sambucus canadensis*) are available, it furnishes nearly 41 per cent. In fall the fruits of sour gum (*Nyssa sylvatica*), Virginia creeper (*Parthenocissus quinquefolia*), and bayberry (*Myrica carolinensis*) become popular, and in winter even the dry outer coatings of seeds of the various sumacs (*Rhus*) and poison ivy (*Rhus radicans*) are sought. Wherever the starling has extended its range into areas in which persimmons (*Diospyros virginiana*) are common, these fruits also furnish it an attractive winter food.

The starling's consumption of various wild fruits results in a certain reduction in the food supply available for native birds. Observers have noted the effect of this depletion on the local abundance of native species, but considering the great abundance of such food available, it is doubtful whether a general shortage has occurred. When feeding on poison ivy the starling acts as a disseminator of this noxious weed, since the embryos of the seeds eaten are not affected by digestion, only the outer coating being removed. In this work the starling adds its influence to that of no less than 66 species of native birds that do the same thing.

MISCELLANEOUS VEGETABLE FOOD

In the Northern States winter compels the starling to lead the life of a scavenger to a certain extent. At this season it is a frequent visitor to the garbage heap, where it feeds on such things as fruit and vegetable parings, orange seeds, beans, and even coffee grounds. Such food items comprise more than 13 per cent of the starling's annual diet. The bird also picks up, probably accidentally, a few weed seeds.

The resourcefulness and energy of the starling in its search for food can be shown no better than by an inspection of the débris found at winter roosts. In common with many of our native birds the starling regurgitates indigestible portions of its food. This material often accumulates in great quantities in towers or other inclosures to which these birds resort. About a quart of such débris, collected at Washington, D. C., in February, 1928, revealed no less than 106 specifically different items, 49 of which were of vegetable origin, including weed seeds, wild fruits, corn, wheat, oats, buckwheat, and vegetable garbage containing considerable quantities of coffee grounds. The remaining items, of animal origin, consisted of beetles, grasshoppers, bugs, wasps, ants, flies, spiders, millipeds, crawfishes, snails, and carrion.

Figure 7 represents diagrammatically the proportions of the various food items of the adult starling, and Table 1 gives the same information in percentage terms.

TABLE 1.—*Monthly percentages of the various items in the food of adult starlings (see fig. 7)*

Kind of food	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Monthly averages
Weevils	14.10	20.16	7.97	4.35	4.31	7.39	13.36	10.91	3.93	3.13	5.33	7.00	8.50
Ground beetles	1.23	0.42	1.07	7.31	8.76	7.96	9.11	13.02	12.93	4.56	1.16	1.12	5.71
May beetles	0.14	------	0.27	4.52	11.04	3.28	4.08	0.45	0.38	2.60	0.10	0.05	2.24
Other beetles	2.27	0.49	2.39	6.55	6.23	4.56	3.70	1.76	0.75	1.15	2.27	5.54	3.14
Grasshoppers	4.42	0.55	2.61	1.59	0.84	1.24	2.77	22.30	30.75	38.95	38.76	4.76	12.41
Caterpillars	3.88	1.04	5.24	5.56	13.97	20.56	4.57	3.69	0.83	2.16	5.69	5.26	6.04
Millipeds	0.44	0.04	0.66	54.69	42.19	23.66	3.68	0.20	4.11	7.64	1.24	2.02	11.71
Miscellaneous animal matter [1]	3.91	3.07	6.23	5.26	6.98	10.80	5.71	5.56	3.56	11.83	3.01	5.05	5.93
Garbage (animal)	1.69	2.40	8.15	1.39	0.63	0.32	0.35	0.32	------	0.23	------	0.36	1.32
Garbage (vegetable)	40.56	35.97	41.25	6.76	4.58	1.04	1.49	0.34	0.54	3.61	------	26.62	13.57
Cultivated cherries	------	------	------	------	------	17.01	14.92	------	------	------	------	------	2.66
Other cultivated fruits	5.84	0.66	2.87	0.76	------	1.06	------	0.50	2.19	0.38	0.96	5.78	1.75
Wild fruits	19.98	32.90	13.69	0.34	------	1.12	35.82	40.88	39.57	23.76	41.80	36.44	23.86
Grain	1.54	2.30	7.60	0.92	0.47	------	0.44	0.07	0.46	------	0.18	------	1.16

[1] Under this heading are included ants, bees, wasps, flies, and other miscellaneous insects, spiders, and mollusks.

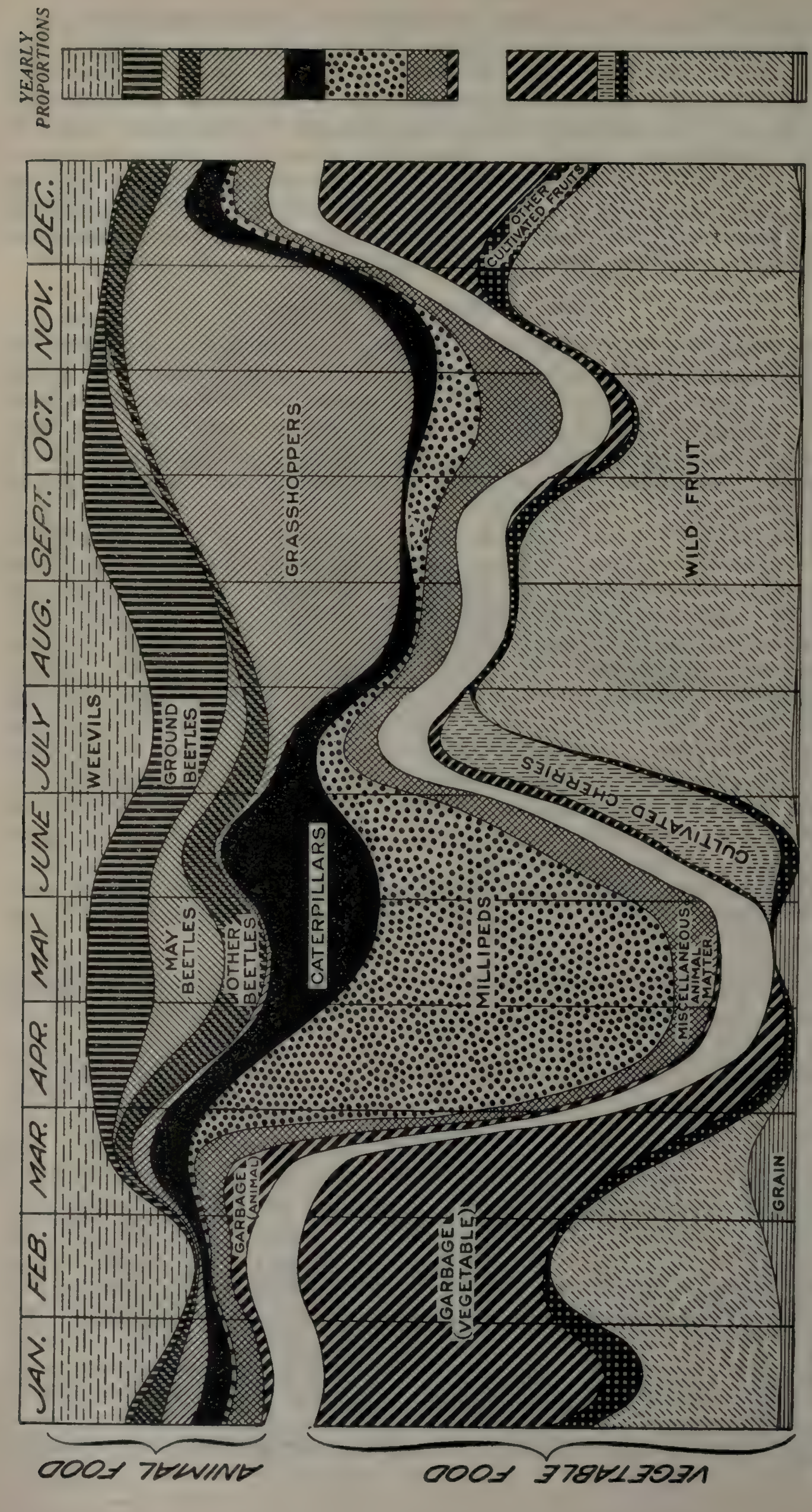

FIG. 7.—Chart of food of adult starlings, showing the varying proportions of the principal items from month to month and the relative yearly proportions of each. The information is shown in percentage terms in Table 1

FOOD OF NESTLINGS

From an economic standpoint the food habits of nestling birds are more favorable, as a rule, than those of the adults, and when one considers that during the nestling period the young birds of many species outnumber the parents two to one, the importance of knowing what they are capable of doing is manifest. It must also be remembered that the food required for the young growing bird is greatly in excess of that needed for its parent. During the first few days of their lives, nestling birds consume enormous quantities of food, estimated in the case of some species to be a mass equal daily to the birds' own weight. This demand for food, much of which consists of injurious insects, is greatest during May, June, and July, a time when growing crops are benefited most by a suppression of their insect enemies.

Few birds are more voracious than young starlings, and it requires the most strenuous efforts of the naturally active parents to supply the constant needs of their offspring when there are from four to six to be fed. Observations made on a brood of five young starlings revealed that they had been fed, on the average, once every 6.1 minutes during the nestling life. On the assumption that the young were fed 12 hours a day, which is conservative, a record of 118 feedings a day would be established. As this brood left the nest on the sixteenth day, probably several days short of the normal nestling period of the starling, for the birds were disturbed considerably during the latter period of their nestling life, a total of 1,888 feedings would have been given to this brood of five, or 377.6 feedings for each nestling. One may get some idea of the quantity of food required to develop a brood of young starlings from the fact that the parent birds would often bring in three or four cutworms, earthworms, or grasshoppers, or an equal bulk of miscellaneous insect food at a single trip.

TABLE 2.—*Monthly percentages of various kinds of food eaten by nestling starlings, showing the changing character at different ages (see fig. 8)*

Age of nestlings	Ground beetles	May beetles, etc.	Weevils	Grasshoppers and crickets	Caterpillars	Millipeds	Spiders	Miscellaneous animal matter	Cherries	Miscellaneous vegetable matter
1 to 5 days	2. 43	3. 91	5. 59	13. 96	45. 26	1. 48	23. 44	2. 98	0. 18	0. 77
6 to 10 days	11. 59	18. 33	4. 49	11. 23	34. 88	5. 34	3. 57	5. 93	3. 36	1. 28
10 or more days	7. 69	18. 25	1. 02	8. 98	37. 81	6. 38	3. 28	7. 61	4. 76	4. 22

A detailed study of the food of nestling starlings gives striking evidence of the great influence they exert for good. More than 95 per cent of the nestling's food is animal matter, largely insects. Cutworms are especially attractive to the young birds, caterpillars as a group forming more than 38 per cent of their diet. The character of their beetle food is economically more favorable than that of the adults, and, though the nestling period is too early in the year to permit extensive feeding on grasshoppers, crickets in large quantities supply their orthopterous food. Spiders are almost sure to be found in the stomachs of nestlings 1 or 2 days old, while millipeds, such favorite food items of the adults, are much less frequently eaten. In the consumption of cherries, the nestling starling by no means equals its parents, or the young that have left the nest.

In summarizing it may be said that the habits of the young materially improve the starling's economic status in the early summer months. In the consumption of destructive caterpillars, scarabaeid beetles, and crickets, three favorite food items of starlings, the young birds excel. Furthermore they destroy fewer beneficial ground beetles and cultivated cherries than do their parents.

Correlated with this demonstrated superiority of the young in food habits is the fact that, bird for bird, nestlings consume more food than adults and that, in the case of the starling, they outnumber the adults 2 to 1. Such an array of favorable testimony makes it scarcely possible to overestimate the relative worth of the nestling starlings. A diagrammatic representation of their food habits at different periods in their life is presented in Figure 8. Table 2 presents this same information in percentage terms.

RELATION TO OTHER SPECIES OF BIRDS

The starling's hole-nesting habits have placed it in intimate contact and frequently in actual competition with native birds of similar habits. This has resulted not only in their usurping the nest sites but in some instances in destroying the eggs and killing the young of native birds. Bluebirds and flickers have suffered most from the starling, but martins, house wrens, robins, English sparrows, and a few other wild species, as well as domestic pigeons, are molested in their nesting operations.

Unrelenting perseverance dominates the starling's activities when engaged in controversy over a nesting site. More of its battles are won by dogged persistence in annoying its victim than by bold aggression. At times the starling carries its irritating tactics to such an extent that it seems almost as if it were actuated more by the morbid pleasure of annoying its neighbors than by any necessity arising from a scarcity of nesting sites. A pair of starlings has been seen keeping vigil for days within a few feet of a flicker's nest containing young, awaiting the first opportunity to enter the cavity should the flickers relax their guard for a moment, but when the flickers had brought forth their young the starlings also departed. A pair of bluebirds had four nests destroyed in rapid succession by a pair of starlings that had already chosen a nesting site. A purple martin, starting to build in a bird house, was promptly evicted by starlings that were nesting near by; the nest material was pulled out and the martins were finally driven away. Young robins have been killed by starlings, and even squabs have been dragged from pigeon lofts and dropped to the ground.

These instances, of course, picture the starling at its worst. If, however, the injurious habits of any other bird were depicted in unqualified form a gloomy picture would be presented. In the case of the starling, many of the nest-despoiling activities occur in the dooryard, where they are almost certain to come under human observation. The driving out of the native species that enthusiastic bird lovers have induced to take up sites in nest boxes also will be more keenly felt than the molesting of breeding birds at a greater distance from the home and with which there has been less intimate acquaintance. A factor seldom considered by bird lovers lamenting these conflicts with native species is the relative value of the starling and some of its breeding competitors based on economic grounds. In this respect the starling is superior to the robin, the flicker, or the English sparrow, and it has food habits fully as favorable as the house wren, which in recent years has been shown to be a nest despoiler. Thus the bluebird and the martin are the only species with which the starling is in intimate competition during the breeding season the economic worth of which may be considered greater than that of the starling.

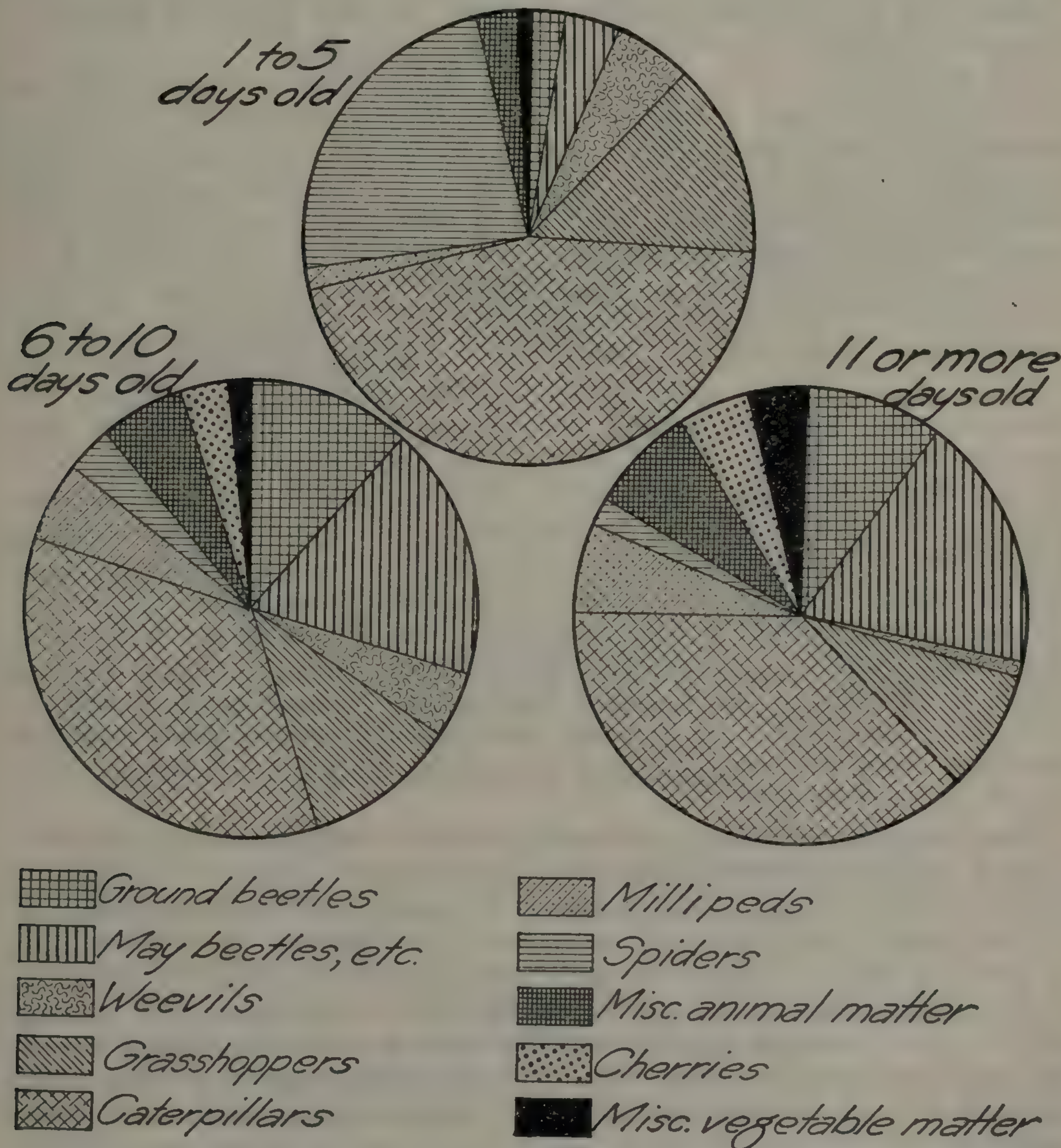

FIG. 8.—Chart of the food of nestling starlings, showing its change in character during three stages of nestling life. The information is shown in percentage terms in Table 2

Bluebirds are common and generally distributed in some of the sections that have been thickly settled by starlings for years, and although observers have noted their disappearance in areas confined to the dooryard or suburban section, it is the opinion of persons qualified to judge the general abundance of birds that in Connecticut and northeastern New Jersey bluebirds have held their own since the advent of the starling and that there is little danger that the race as a whole will be placed in jeopardy by the newcomer. In fact, bluebirds continue to nest commonly in localities far from human habitation, where they have little to fear from starlings. Furthermore, in the dooryard their nests, eggs, and young may be protected by providing nest boxes having an opening no greater than 1½ inches in diameter, through which the starling can not pass.

The flicker also will be driven from the vicinity of houses, but it, too, will always find a refuge in the wilder situations to which the starling goes less frequently. In some parts of Connecticut, New York, and New Jersey, where in 1916 the starling was a common bird and had been in competition with the flicker for at least 15 years, the latter still maintained as conspicuous a place in the bird world as it had in other parts of those same States where the starling had not yet arrived. This also can be said of the robin, which in northeastern New Jersey and in the Hudson Valley, and along the Connecticut shore, is an extremely abundant bird, perhaps even too abundant for the best interest of the small-fruit grower. In 1916 martins were more abundant in western, central, and southern New Jersey than nearer the center of starling population, but such a condition of relative abundance existed before the advent of the starling and could not be construed to result from starling aggression. Neither can the apparent decrease in the English sparrow population throughout New Jersey and parts of New England since 1910 be correlated with the spread of the starling, since in many sections where a decrease of the sparrow was noted the starling had not yet arrived in numbers. As for the other species at present known to be attacked by starlings, the acts of vandalism are so occasional that the effect is negligible.

The increasing scarcity of nesting sites available to native hole-nesting species becomes apparent as the country is more thickly settled. To meet the growing need it is incumbent on bird lovers to furnish ample facilities in the shape of nest boxes. It will be well to provide for the needs of both native species and the starling. Such a procedure will tend to reduce the competition for nesting sites, and at the same time those who wish to reduce the local breeding population of starlings can do so by equipping nest boxes with the trap device mentioned in the following section, on control measures (p. 26).

Field observation sheds some light on the added competition for food imposed upon native species by the presence of the starling. During the breeding season, robins in suburban sections and meadow larks in the more open country are the species thrown most intimately in contact with the newcomer. Immediately after the breeding season the starling associates with cowbirds, red-winged blackbirds, and grackles, but, strange to say, the food preferences exhibited by the starling do not seriously conflict with those of these species.

Probably the greatest influence exerted by the starling upon the food supply of other birds is occasioned by its consumption of wild fruit late in summer and early in fall. Wild-cherry and sour-gum trees heavily laden with fruit are soon stripped when a flock of several hundred starlings feeds continually in the vicinity, and, although the total supply of this food is enormous, instances have been observed where locally such birds as robins, catbirds, and cedar waxwings have been compelled to seek other sources of food. During winter starlings obtain a certain portion of the food formerly eaten by English sparrows, especially about the dumping grounds of cities. Where bird lovers have taken pains to attract native species they have often found the foreigner greedily consuming all they can supply, with the result that in some localities the high cost of attracting birds approaches the prohibitive point.

Here again must judgment on the relative worth of the species concerned be rendered before the seriousness of the starlings' consumption of the former food supply of other birds can be understood. After carefully weighing all the evidence available, it is safe to state that in the Northeastern States the starling is economically the superior of the robin, the catbird, the red-winged blackbird, the grackle, the cowbird, or the English sparrow. This leaves the meadow lark as the only highly desirable species materially affected by this competition for food.

CONTROL MEASURES

Despite the fact that starlings in normal numbers exert an influence for good and may well be left unmolested when not inflicting noticeable damage, there are times and circumstances under which they may become objectionable, or even decidedly injurious. This section on control measures has been included to supply information useful in overcoming the objectionable traits of these birds, or reducing their numbers where they have become unduly abundant locally.

ERADICATION OF ROOSTS

For the removal of objectionable tree roosts of starlings, a number of methods have been employed, but none at present in use assures lasting success. The attraction that some particular group of trees holds for flocks of starlings, as well as for grackles and robins, and sometimes for cowbirds, English sparrows, and purple martins, is not easily overcome. If vigilance is not employed, temporary eradication may be followed by reestablishment of the roost.

Experience gained through attempts to remove starling-grackle-robin roosts in Connecticut and northeastern New Jersey has shown that the use of shotguns is effective, at least temporarily, and can be recommended wherever State and local laws permit. Five or six successive nights of attack are usually sufficient to cause the birds to move on. It is not necessary to kill many, benefits being derived from the frightening effect of the gun fire, coupled with misfortune visible to other members of the flock. For this reason the most effective work can be done early in the evening, when the first birds arrive. When there is still daylight the frightened birds will fly for some distance before alighting, whereas later in the evening they will move only a few yards from their perches. Shells loaded with black powder will produce a more deafening report and will frighten the birds more than those loaded with smokeless powder.

In a few places where the use of shotguns was impracticable, satisfactory results have been obtained through the use of powerful Roman candles discharged among the roosting birds. A roost at Hartford, Conn., was removed by such means, but at some of the populous and long-established roosts in northeastern New Jersey such tactics were less successful than the use of the shotgun. The application of a stream of water from a fire hose has been resorted to with success on occasions, as well as milder forms of frightening operations, such as the use of electric lights and bells and other noise-producing apparatus, but as a rule the less drastic measures have little effect on large and long-established roosts. In any case, however, after the birds have moved on, careful watch must be kept until the advent of cold weather to prevent attempts to reoccupy the roost.

When starlings resort to window ledges, fire escapes, and sheltered spots beneath the eaves of buildings on the business streets of cities, the problem of roost eradication becomes more difficult. Gunfire, pyrotechnics, and even the fire hose can not always be used, and the milder forms of frightening procedure usually are ineffective. The employment of bird minders to patrol the area infested and to frighten the birds from beneath overhanging eaves and protected ledges throughout the winter months is expensive, and in periods of sleet and rain the work is unpleasant and even hazardous.

To meet such situations the use of netting or seine of 1-inch square mesh and made of about No. 6 cord often will solve the problem. Usually only a narrow strip of netting reaching from the edge of the overhanging eaves and stretched tightly and neatly down to the windows of the top or next to top story will completely exclude the birds from their roosting perches. Such netting can be purchased from manufacturers of nets at a cost of about $1.25 per 100 square feet, exclusive of charges that may be made for edging the nets with rope or constructing them in unusual sizes or shapes.

Starlings roosting in church towers, where they have sometimes become a nuisance on account of the accumulated filth, can be excluded by the use of wire screen of a mesh of 1 inch or less. This method is commonly adopted in areas thickly populated with starlings.

FUMIGATION

Suggestion frequently is made that toxic gases might be used as a means of removing objectionable roosts of starlings. Under conditions prevailing at tree roosts the danger to human beings and to the life of the trees themselves is too great to warrant the release of toxic gases in concentrations dense enough to kill birds. Experiments with a number of gases that have been used in warfare have demonstrated that concentrations approximately one-third the human lethal dose or greater are necessary to give consistent results. To carry such a concentration to the treetops over any considerable area in residential sections of cities would require the release of gases in such densities that, near their source, they would be far above the human lethal dose. Furthermore, gas clouds when once released are subject to the fickleness of air currents. For these reasons their use has not been recommended.

In inclosures where toxic gases can be confined and otherwise controlled, however, there are possibilities in their use against starlings when unduly numerous. Probably the most workable of these is hydrocyanic-acid gas. This is highly toxic and is frequently used in greenhouse as well as outdoor fumigation against insect pests. Experimental work is needed to determine the correct concentration of this gas for the most economical and effective control work against starlings and for the development of a technic that will give the most satisfactory results. In any event, such operations must be conducted only by persons thoroughly familiar with the handling of this highly toxic gas and in conformity with any local regulations regarding its use.

Crude calcium cyanide in dust form, which has found increased use as an insecticide in recent years, also has been found effective as a fumigant against English sparrows and starlings roosting in vines of ivy or Virginia creeper on the sides of buildings or on ledges and window sills under partially inclosed porticos. Calcium-cyanide dust on coming in contact with a humid atmosphere produces hydrocyanic-acid gas, and for this reason it should be used only by persons thoroughly familiar with the attendant dangers. The fact that it can be applied with portable dust guns, by which the density and size of the dust cloud can be readily controlled, makes for greater safety and convenience than do other methods of generating hydrocyanic-acid gas.

A small hand-operated dust gun, having only a few feet of hose and tubing from which the dust cloud is expelled, has been used effectively in killing English sparrows roosting as high as the top of the second story of buildings. After all near-by windows have been tightly closed a dust cloud is released near the ground. This produces a volume of hydrocyanic-acid gas that on calm nights will slowly rise, passing up the side of the building and penetrating all the spaces between overlapping leaves beneath which the birds customarily roost. By using extensions to the tubing attached to the duster higher roosting spots can be reached. A period of a minute or more may elapse between the time the dust cloud is released and the time the first birds receive lethal doses and begin to drop. Although starlings are more responsive to nightly disturbances than are English sparrows and are more likely to fly from the gassed area, with ordinary precautions they may be reached.

OTHER METHODS OF CONTROL

No extensive poisoning experiments against starlings have yet been carried out. The preference of these birds for an animal diet largely of insects during the spring, summer, and early fall precludes successful poisoning operations against them at those seasons. During winter, however, when they feed extensively on scattered grain and a variety of other items from garbage heaps and municipal dumping grounds, the chances for success should be better. At the localities mentioned there would be little danger to any species other than starlings and English sparrows.

Bird banders have been successful in trapping starlings in the sieve type of trap, tilted up on one edge by a short stick that is jerked out when the birds are feeding beneath. Even the funnel type of trap will catch starlings when the ground is covered with snow and the birds are hard pressed for food. The nest-box trap used against English sparrows can also be employed against starlings and should find favor with those bird lovers who deplore the aggressions of starlings against native species at nesting time. Descriptions and illustrations of these and other traps that, with slight modification in size, should prove satisfactory for starlings are presented in Farmers' Bulletin 493, The English Sparrow as a Pest.

UTILIZATION AS FOOD

The ease with which starlings may be captured in church towers and other winter-roosting inclosures at night by aid of electric flashlights has given rise to the suggestion that an undue increase of these birds might be prevented by recommending their use as food. There is some merit to this suggestion, although the rather strong, gamy flavor of the starling's flesh will probably limit its popularity from a culinary standpoint. When the breasts of these birds have been soaked in a soda-salt solution for 12 hours and then parboiled in water, which is afterwards discarded, they may be used in a meat pie that compares fairly well with one made of blackbirds or English sparrows.

CONCLUSIONS

Most of the starling's habits are either beneficial to man or of an economically neutral character. Field observation has established the fact that the time spent by starlings in destroying crops or in molesting other species of birds is extremely short compared with the endless hours they spend searching for insects or feeding on wild fruits. There is no question that the influence of the European starling, in moderate numbers, in the United States is beneficial. As a destroyer of such pests as the clover-leaf weevil, the Japanese beetle, May beetles, cutworms, and grasshoppers it is even more energetic than some of our protected native birds.

Nevertheless the starling has certain tendencies for harm. These have been intensified by the bird's flocking habits, as well as by a general increase in abundance in recent years, and have led to insistent demands for a curtailment in numbers. It can not be denied that the bird inflicts damage to cherries, other small fruits, certain garden truck, and even late fruit and corn, and that it is the direct cause of the disappearance of certain native birds from the dooryard.

No doubt there are local areas in which the starling is detrimental to agriculture and horticulture at the present time, but the factor of overabundance rather than pronounced tendencies for harm on the part of the individual bird has brought this about. The same factor, too, has been important in making its roosting habits objectionable in residential and business sections of cities. To remedy such conditions it would appear that local control is the logical procedure. The suggestions for measures to combat the starling have been included in this bulletin with that object in view.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

November 21, 1928

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1572

MAKING CELLARS DRY

MANY KNOW the annoyance and ill effects of wet basements and cellars, but comparatively few are familiar with good remedial methods. This bulletin gives needed information and supersedes Year Book Separate No. 824, "Securing a Dry Cellar."

Many wet cellars might be dry had a little more attention been given to their location and construction and to grading the earth around them to shed water quickly. Frequently wet cellars can be made dry by gravity drainage of the site—the simplest and surest method of avoiding ground-water troubles. Many damp cellars can easily be made less damp by better window ventilation. Water-tight construction and waterproofing and damp-proofing methods require good materials, but the most important thing—in fact the vital thing—is thorough workmanship in each and every detail.

Washington, D. C. Issued July, 1929

MAKING CELLARS DRY

By George M. Warren, *Associate Hydraulic Engineer, Bureau of Public Roads*

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INTRODUCTION

A person who proposes to build, buy, or rent a house should consider the possibility of water and dampness in the cellar. Discovery of trouble after occupancy causes inconvenience and expense. Houses with wet cellars often stand idle for months and sometimes for years. Such cellars feel colder than dry cellars of the same temperature, and because of lack of windows and ventilation they are often dark and musty. Real estate dealers say that a good dry, light cellar adds $500 to $1,000 to the value of an ordinary dwelling. Moisture and darkness favor mildew, molds, decay, and putrefaction; moisture also hastens the corrosion of metals. Hence, a dry cellar makes for wholesome, sanitary conditions in the home; promotes personal comfort and health; lengthens the life of houses, furnishings, and plumbing; and increases the usefulness of basements for storage, workshop, and laundry purposes.

LOCATION

It is better to avoid mistakes than to correct the consequences. Where a choice is possible careful consideration should be given to the selection of the site for a new cellar. The following are important points to be observed:

(1) The site should be moderately elevated so that a fall in at least one direction is obtained. Many prefer a " perched " site because of commanding view, better movement of air, greater depth to the water in the ground, and superior surface and underground drainage. Others prefer to forego some of these advantages and select sites sheltered from strong winds, especially those likely to bring stormy or cold weather. Figure 1 shows a good site and two that are less favorable.

(2) The soil and subsoil should be open and porous so that air and water are admitted readily. Examples of such soils are sands, gravels, and loams.

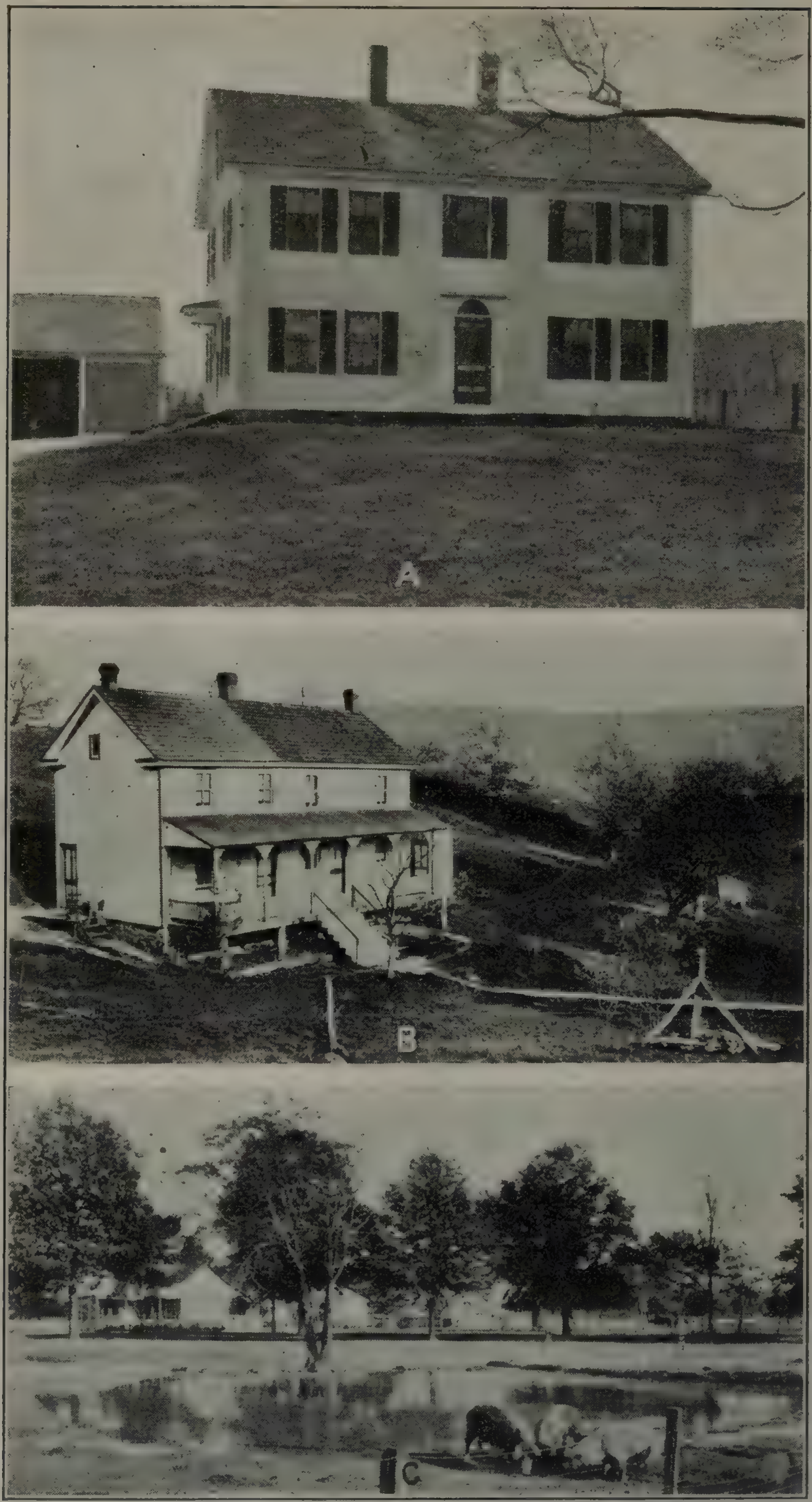

FIGURE 1.—Sites: A, Excellent; B, sidehill sites are subject to upland drainage; C, pond and flat ground indicate shallow drainage

(3) The site should have good, deep, natural drainage. During the wet season of the year the ground water should be at least 10 feet below the surface of the ground. A depth of 15 feet insures still better aeration and ventilation of the ground. As to the distance between the cellar botton and the ground water, much depends on the character of the intervening earth and the type of floor used. In the same way that oil rises in a lamp wick or ink penetrates blotting paper, water will pass into the minute spaces or pores existing in all kinds of soil and the softer varieties of rock. This absorption, or capillary rise, in coarse sands may not exceed 2 or 3 feet, but in very fine sands, silts, loams, and clays it may range from 5 to 8 feet. In lateral directions the movement may extend much farther.

(4) No site should be chosen until the source of the domestic water supply has been determined, its purity and abundance have been assured, and the location of a suitable plot of ground in which to waste sewage or other foul drainage has been fixed upon.

CAUSES OF DAMPNESS AND WETNESS

There are many causes of damp or wet cellars. Sometimes the trouble is slight, resulting from an apparent and easily remedied local cause. Sometimes the trouble is serious, resulting from hidden and not easily corrected causes. The cause or causes should always be studied and determined, so that the simplest effective treatment may be employed. The principal causes are as follows:

(1) Land which is flat or slopes toward the cellar wall, down and through which percolates rain and melting snow. The drainage may be over the surface or underground and usually results in damp spots, or standing water at cellar corners and along the junction of floor and walls, as shown in Figure 2, A. The conditions are usually worst in the spring of the year when the ground is very wet; in compact soil having poor natural drainage; on the upper side of side-hill cellars; and in poorly constructed cellars like those in Figure 2.

(2) Absence of eaves troughs and down spouts, or failure to repair defective ones, frequently resulting in surface depressions, muddy pools, bespattered walls, and water-soaked ground near or against the cellar wall.

(3) Ground water close to the cellar bottom through which water rises by capillarity, producing merely dampness.

(4) Ground water higher than the cellar bottom, causing standing water in the cellar and at times excessive dampness in the rooms above.

(5) Sweating or condensation of atmospheric moisture on walls, floors, and other cold surfaces within the cellar.

(6) Leaky plumbing; drip from ice chests and sill cocks; dense masses of vines, shrubbery, and trees.

In contrast to the poorly constructed cellars shown in Figure 2, attention is called to the appearance and usefulness of the good cellars shown in Figure 3.

ROOF WATER

Buildings having cellars generally should be provided with eaves troughs (gutters) and down spouts (conductors or leaders). A common type is shown in Figure 4, A. Troughs should be kept in

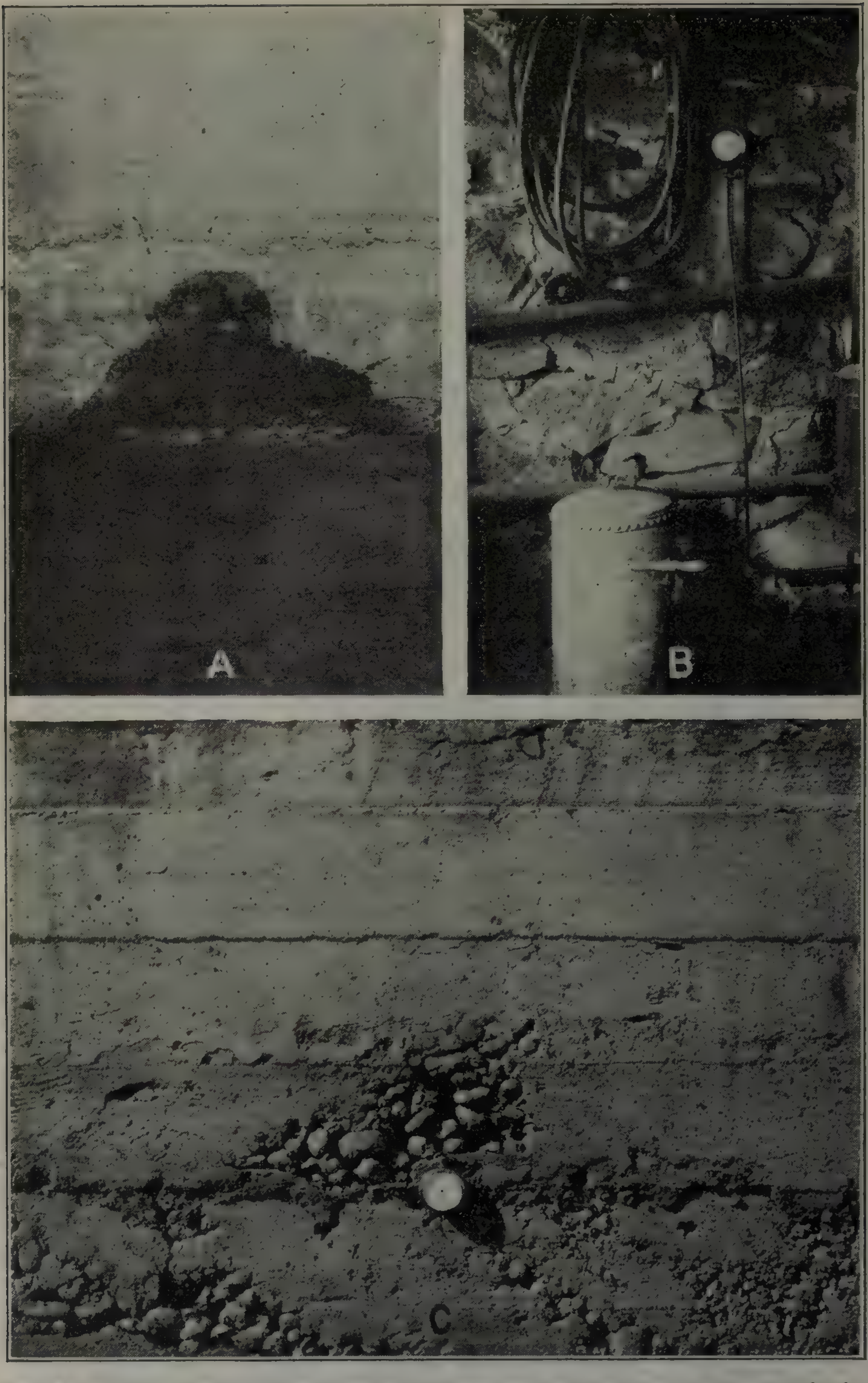

FIGURE 2.—Poor construction and water-tightness are incompatible: A, Water finds the weak spot at junction of floor and wall; B, rough rubble wall; C, poorly spaded honeycombed concrete wall

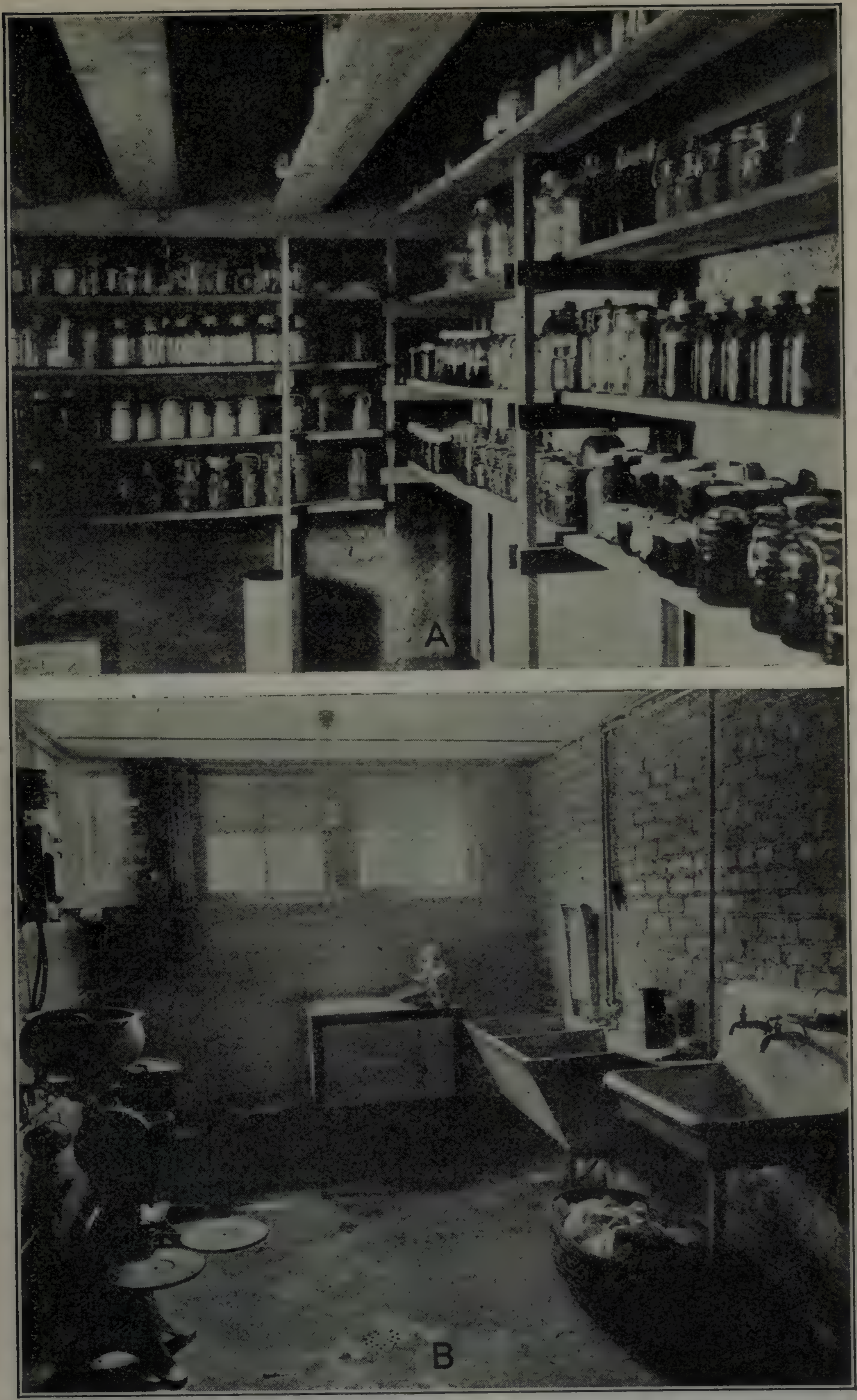

FIGURE 3.—A dry, light cellar is more useful than one that is damp and dark: A, Vegetable and fruit storage cellar; B, farmhouse basement, Illinois

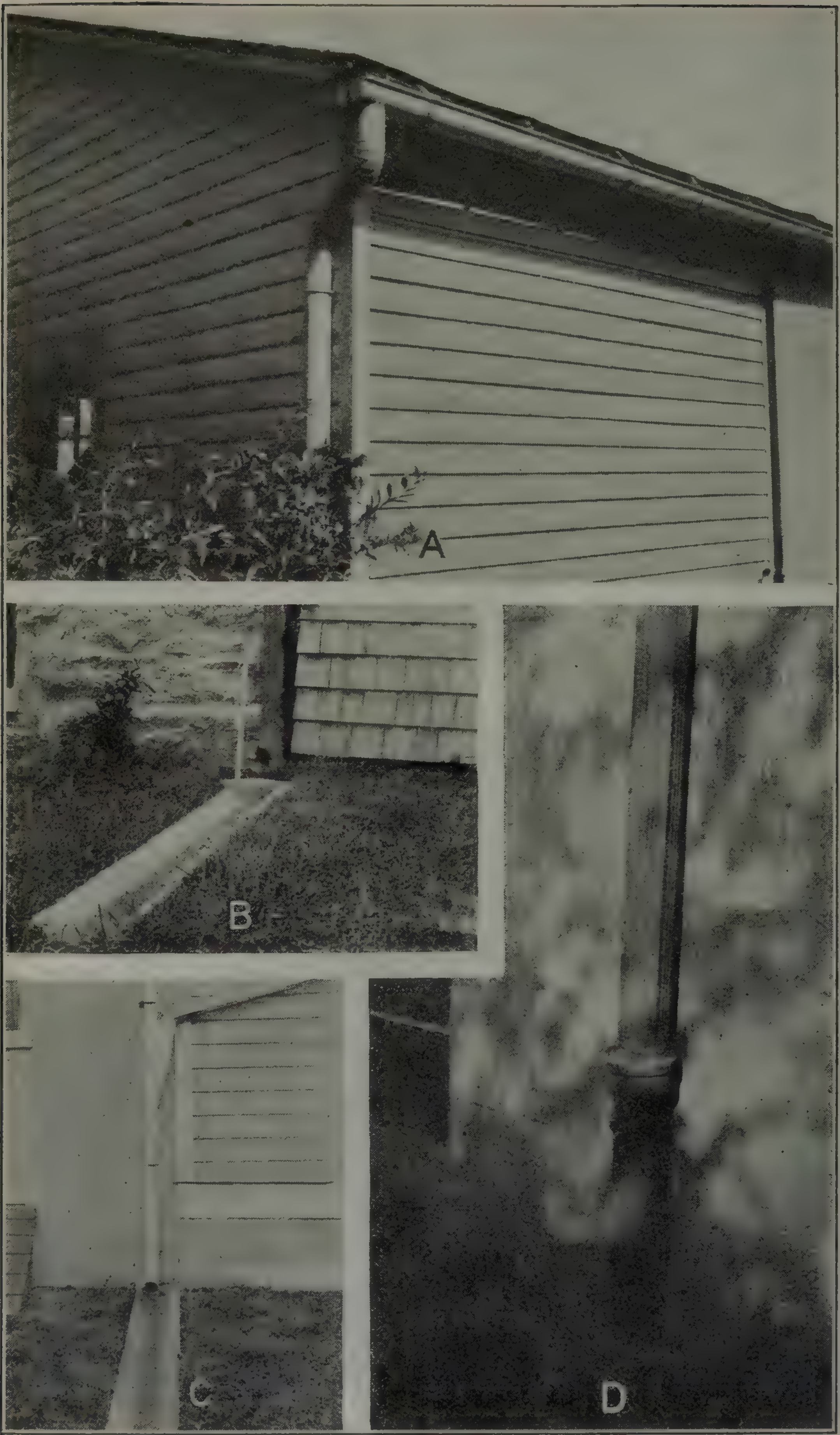

FIGURE 4.—How to lead roof water away from buildings: A, Half-round galvanized gutter, end piece, elbows, and plain round conductor; B, concrete gutter with upper end enlarged to catch all the discharge from the conductor shoe; C, concrete gutter 2 inches deep, 9 inches wide, and 10 feet long; D, square corrugated conductor cemented into a connection of ordinary 4-inch cast-iron soil pipe

good repair, well painted, and free from twigs, leaves, and other obstructions. Where the nearness of trees is likely to cause litter to collect in the trough, the trough outlet should have a basket-shaped wire strainer. Where the down spout from such a trough is so connected as to discharge underground as shown in Figure 4, D a strainer is especially useful in preventing obstruction in the drain.

Study of the intensity and frequency of rainfall in the United States indicates that there are few localities where provision need be made for removing more than 4 inches per hour from the roofs of farm buildings. Heavier rains may and do occur, but they are usually accompanied by strong wind which blows some of the water clear of the eaves troughs, and they are likely to come during those seasons of the year when a small spill from the roof does little harm. Table 1 shows suitable sizes of eaves troughs and down spouts for roofs of varying horizontal (ground plan) area. The figures in Table 1 are based on a 4-inch-per-hour rainfall and on commercial sizes of round down spouts and half-round eaves troughs sloping one-tenth inch per foot. Square, rectangular, or other shaped sections of equal area may be used.

TABLE 1.—*Sizes of half-round eaves troughs and round down spouts for various roof areas*

Area of roof (horizontal), (square feet)	Rainfall per minute, (gallons)	Eaves troughs (nominal size)	Down spouts (nominal diameter)
		Inches	*Inches*
100 or less	4 or less	3½	2
100 to 800	4 to 33	4	3
800 to 1,000	33 to 42	5	[illegible]
1,000 to 1,400	42 to 58	5	4
1,400 to 2,000	58 to 83	6	4

Spacing of down spouts varies with their size and with the area and type of roof. A plain gable roof (center ridge) 30 to 40 feet long would ordinarily require two 3-inch down spouts—one for each slope—placed at the same or opposite ends of the roof according to the slope and drainage of the grounds. A gable roof 60 feet long would ordinarily require four 3-inch down spouts, one at or near each corner. The eaves trough would slope up from each corner forming a summit or high point midway between down spouts. If it is necessary or desirable to slope them away from instead of towards the corners, two 4-inch down spouts about midway of the roof would be sufficient. Hip or pyramid roofs 30 feet square ordinarily require two 3-inch down spouts, one at or near either diagonal corner, summits being formed in the eaves troughs at the other two diagonal corners. Large hip or pyramid roofs usually have four down spouts, one at or near each corner.

A down spout usually has an elbow or shoe which discharges slightly above ground and away from the cellar wall. It is very important, especially where the ground is flat or drains poorly, to avoid concentration of water at any point. A simple and satisfactory way of leading the discharge away from the cellar wall is shown in Figure 4, C. This is a homemade concrete gutter 2 inches deep, 9 inches wide, and 10 feet long, sloping about 1 inch per foot and with edges flush with the ground surface.

Sometimes V-shaped or U-shaped gutters of wood, brick, or stone, or a few lengths of half-round, vitrified gutter pipe are used. To catch all the discharge from a down spout the upper end of the gutter is frequently widened and shaped like a platter, as shown in Figure 4, B.

Wasting roof water on the surface has the advantage of permitting ready inspection and clearing of down spouts should they become obstructed. Frequently the discharge is piped underground to a suitable drain, abandoned well, dry well or surface outlet 15 or more feet from the building. About 2 feet above ground, as shown in Figure 4, D, the down spout is cemented into a piece of cast-iron pipe extending to a quarter-turn elbow set below frost depth. The line to the well or outlet is completed with ordinary draintile or sewer pipe with cemented joints. The bottom of a dry well should be lower than the cellar bottom and in earth or rock that drains rapidly. To facilitate the removal of obstructions in the elbow or drain, it is a good plan to set in the cast-iron riser a Y cleanout or branch with removable plug just above the ground surface.

SURFACE DRAINAGE

Many a cellar is wet because the surrounding ground is flat or slopes toward it. Such a cellar may be improved by grading the ground to form a smooth, sharp, downward slope extending at least 10 feet from the building, thus insuring quick shedding of surface water. Water in the ground moves much more rapidly downward than laterally. Hence, if surface water can be carried quickly away from a cellar wall, a large part of that which enters the ground will probably sink below the level of the cellar rather than spread laterally to it.

Setting dwellings too low is such a common mistake that the old adage, " decide on the grade of the sill and then set it a foot higher," is not far amiss. A fairly good rule is to make the top of the cellar wall at least 1 foot plus the height of the cellar window sash above the highest point of the finished grade or ground surface 10 feet from the building. For example: With level ground and a window sash 1 foot 3 inches high, the frame being set flush with the top of the cellar wall, the top would be 2 feet 3 inches above the ground. Although this allows a ½-inch-per-foot slope in the grading (average sidewalk slope) with the bottom of the window sill about 3 inches above the graded dirt, it is undoubtedly wise in many instances, especially where the ground water is high and the natural drainage is poor, to make the cellar bottom and wall a little higher and to steepen the grading as shown in Figure 5.

Where existing buildings are too low and it is necessary to grade as high as the cellar windows, a curved or rectangular wall of concrete, brick, or tile may be built about them as shown in Figure 6.

After the grading is completed it should be seeded with a good lawn grass, raked, and rolled. Handled in the manner described, a sharply sloping, well-sodded zone around a building does much to carry off surface water, keep the cellar dry, and improve the appearance of a low-set building.

The space between cellar walls and the excavation is usually back filled with loose dirt and more or less waste material, such as pieces of stone, broken bricks, and bits of wood and mortar, the whole forming a porous medium for the easy passage of water to the wall. The space should be filled and compacted with clayey material or, if not too wide, with concrete. Where the filling has been poorly done, and in order to shed water quickly, a sloping pavement or gutter is sometimes laid as shown in the upper view of Figure 7. The pavement may be made of Portland-cement concrete or bituminous concrete and is usually 1 to 3 feet wide.

If it is necessary to conduct water along a cellar wall the pavement should be shaped like the gutter in Figure 7, B, and given a slight, smooth grade its whole length. A gutter 18 inches wide, 3 inches deep, and graded 1 in 100 is ample for the largest farm dwelling.

Where a considerable area of land slopes toward a building it is advisable to intercept surface drainage at a distance from the cellar. This can usually be done by scooping out a small, half-round drainage ditch to run through any slight depressions along the contour of the land. If a ditch is objectionable, draintile, with one or more catch basins at low spots, may be laid.

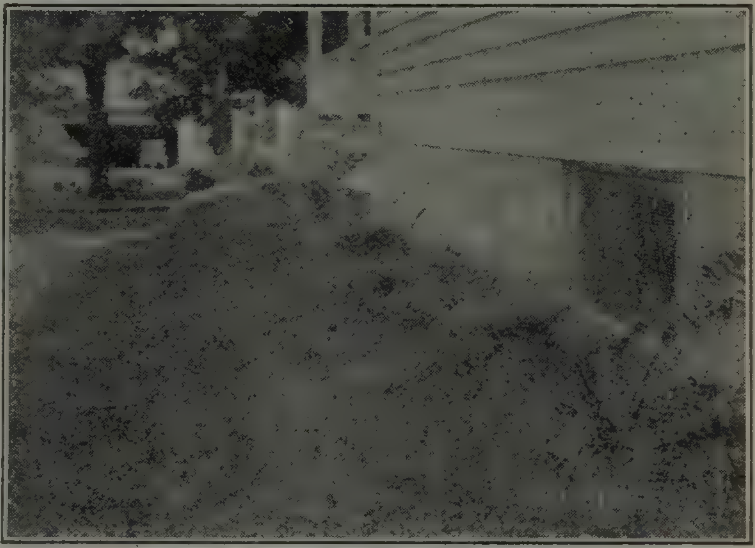

FIGURE 5.—Earth graded sharply to shed water from a cellar wall

GROUND WATER

The importance of deep thorough drainage of building sites can not be overestimated. Where seepage works or may work through a cellar wall or where the ground water is or may rise higher than a cellar floor, a drain should be constructed, provided a drainage outlet can be obtained within reasonable distance. Even where special waterproofing measures are employed it is a wise precaution to drain off the ground water as low as or lower than the bottom of cellar walls and the under side of cellar floors.

The usual practice is to lay a 4-inch tile drain, as shown in Figure 8, close to the bottom of the cellar wall or footing course on the side or sides from which water comes. About a foot extra width is excavated to give space for laying the drain. The bottom of the tile should be as low as the bottom of the wall or footing course but care must be used never to undermine it. The drain is usually laid with little slope because down spouts are not connected to it and hence it carries comparatively little water. Both the line and slope of the drain should be straight and smooth. Good concrete pipe, well-burned draintile, or ordinary sewer pipe may be used. The joints should be kept open about the thickness of a knife blade, and to prevent entrance of loose dirt a strip of burlap, linen, or other porous fabric 6 inches wide and about 17 inches long should be tied or wired around each joint. The trench should then be refilled with screened gravel, broken stone, cinders, or other coarse material up to within a foot of the surface of the finished grading. It is desirable to use gravel or stone from ¼ to 1 inch in size, placing some of the finer around and over the pipe to give good bedding and protection.

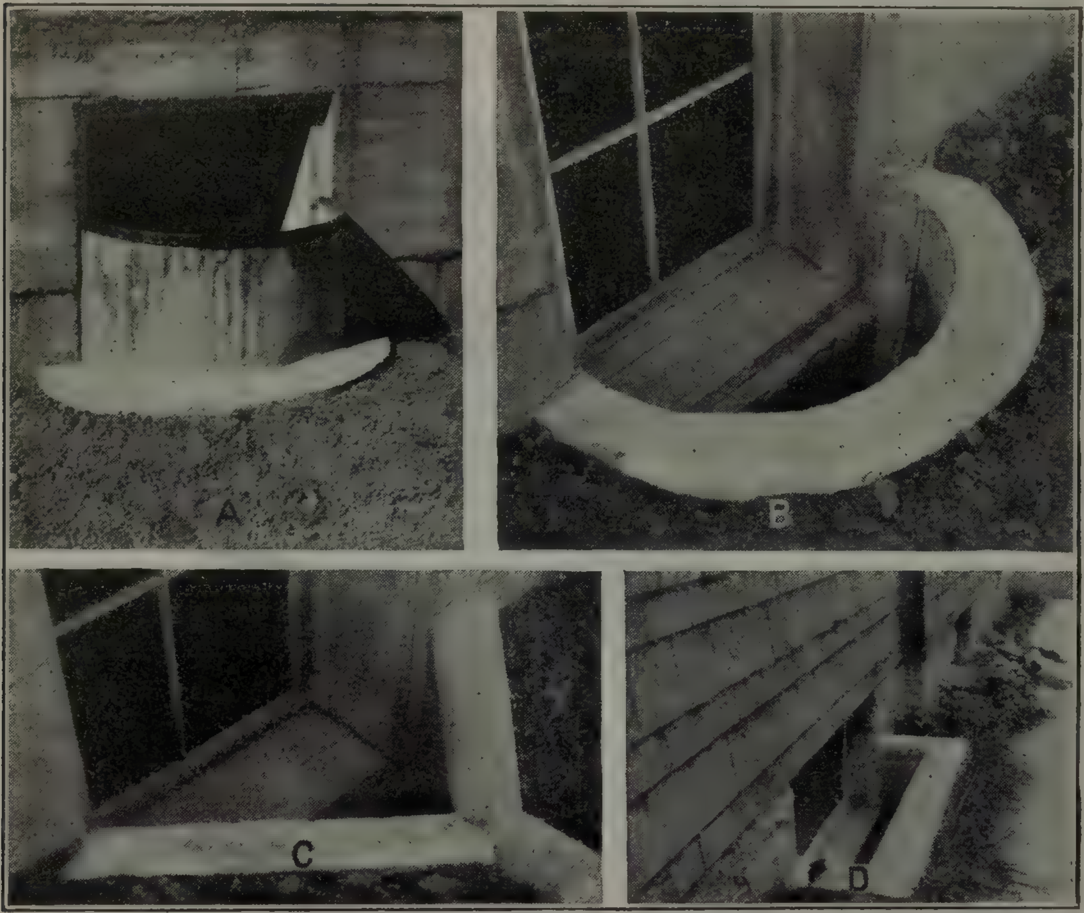

FIGURE 6.—Shallow concrete walls to restrain grading around cellar windows: A, Steel form used to shape a half-round concrete wall; B, completed well 20 inches deep; C, V-shaped well; D, shallow rectangular well

To prevent loose dirt washing down into the stone or cinders, the top should be covered with old bagging, burlap, hay, straw, cornstalks, sods with grass side down, or fine brush. On this mat about a foot of topsoil is placed, graded, and seeded as previously described.

A drain and belt of coarse material thus placed around a cellar wall not only collects and carries off seepage water but is effective in intercepting dampness. The method is especially suitable on the upper side of hillside locations because a drainage outlet can usually be obtained within a short distance. If necessary to drain deeper than the foundation the drain may be placed 4 or 5 feet away to avoid undermining it. It is sometimes desirable to lay one or two branch drains to tap springs within a cellar.

CELLAR DRAINERS

Where gravity drainage is impossible or impracticable, cellar drainers or pumps are often employed to raise the water to the surface, whence it runs away through a gutter or pipe. These appliances are small, simple, and compact and are installed in a pit 1½ to 2½ feet deep at the low corner or other wet spot in the cellar. To admit ground water and to prevent caving of the sides, the pit is curbed with a length of large draintile or sewer pipe, with concrete, brick, or stone, or with a keg or strong barrel having a few ½-inch holes in its side and bottom. Drainers of the ejector type are operated by water or steam under pressure, the high velocity of a small jet entraining the pit water and lifting it, together with the jet water, from the cellar. Pump drainers are usually operated by small electric motors. Both types of drainer are shown in Figure 9.

Drainage usually reaches the pit slowly and intermittently, depending on soil conditions and rainfall, and drainers are equipped with a float valve to make their operation automatic. If correctly installed and not abused, drainers require very little attention. Dirt, trash, laundry lint, or other wastes, which may clog the strainer should be kept out of the pit.

CELLAR CONSTRUCTION

Good cellar construction lessens the liability to future trouble. The following suggestions will prove helpful.

(1) The cellar wall should be started on a firm, dry, level bottom or on a substantial concrete footing course at sufficient depth to give a clear height of not less than 6½ feet from the finished cellar floor to the bottom of the main beam supporting the first-story floor joists. Although a deep cellar may be damper than a shallow one, it is well to note that uniformity of temperature tends to increase with depth. The temperature of natural ground at 5-foot depth is rarely more than 15° above or 15° below the mean annual air temperature of the locality; at 10-foot depth the corresponding range is rarely more than 10° above or 10° below the mean. Old-time New England milk cellars, sometimes 15 or more feet in depth, have notably cool, even temperatures.

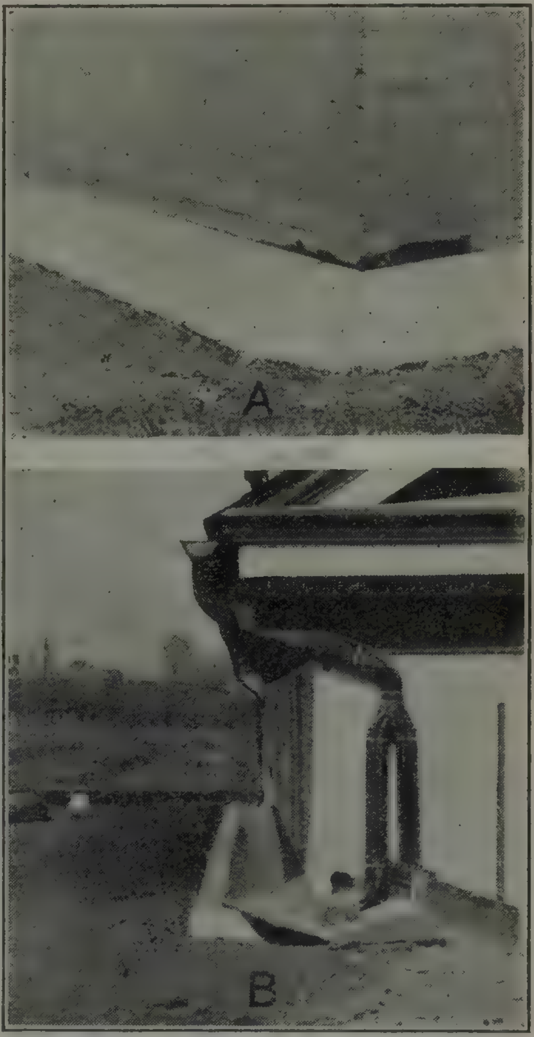

FIGURE 7.—Sloping concrete pavements about 18 inches wide: A, Shedding water from a cellar wall; B, conducting water along a cellar wall

(2) Availability and cost usually determine the wall material. Stone, brick, concrete, solid or hollow concrete blocks, and very strong, dense, vitrified, hollow clay tile are in common use. Plastering the outside of stone, brick, or other jointed masonry walls with a ½-inch coat of 1:1½ Portland-cement mortar is a great aid in shedding water down the wall and keeping it out of the joints.

(3) For one and two story dwellings and similar structures the cellar walls should not be thinner than 16 inches for rubblestone, 12 inches for brick, solid or hollow concrete blocks, or clay tile, and 8 inches for solid concrete.

(4) Ample windows should be provided for light and ventilation. Although a well-lighted living room has about 1 square foot of unobstructed glass per 100 cubic feet of room space, the results are generally satisfactory for ordinary cellar purposes if there is 1 square foot of unobstructed glass per 300 to 400 cubic feet of cellar space. There are, of course, many factors, such as intensity of the light, reflection from adjacent buildings, direction of exposure, size of cellar, presence or absence of partitions, and color of partitions, walls, and floor, which strongly influence cellar lighting. The preferable location of windows is one on each side to allow illumination of opposite walls and free movement of air (ventilation) across the cellar. Clean, smooth, whitewashed, or Portland-cement grout painted walls greatly improve the lighting effect.

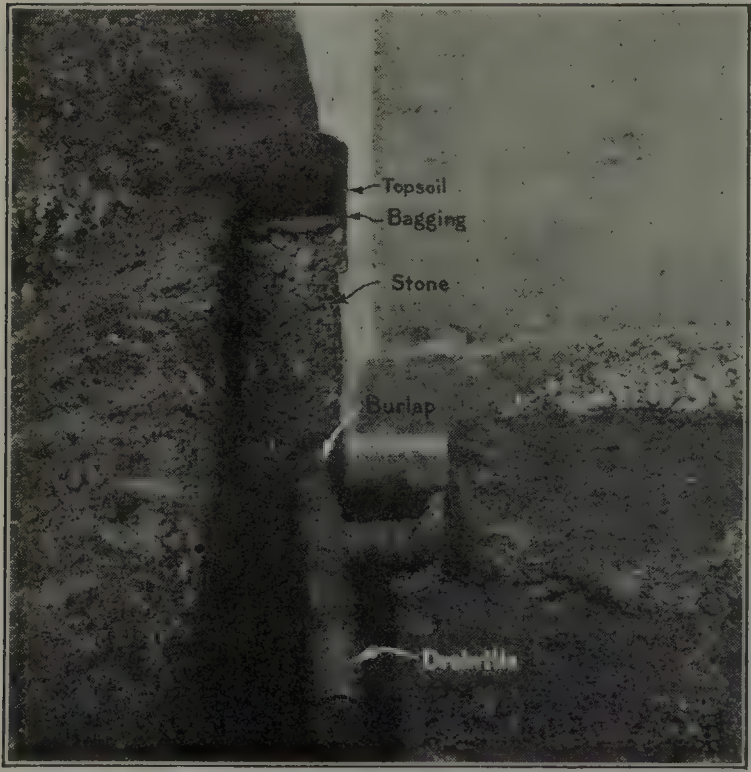

FIGURE 8.—A good drain along the outside bottom of the foundation is the most effective remedy for a wet cellar

(5) The cellar should have a good, even, concrete floor about 4 inches thick. Directions for the selection of materials and the proportioning, mixing, and placing of concrete in floors and walls are given in Farmers' Bulletins 1279 F,[1] Plain Concrete for Farm Use, and 1480 F,[2] Small Concrete Construction on the Farm, copies of which are mailed free on request by the U. S. Department of Agriculture. The floor should be given a slight slope in one or two gen-

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[1] MILLER, T. A. H. PLAIN CONCRETE FOR FARM USE. U. S. Dept. Agr. Farmers' Bul. 1279, 27 p., illus. 1922.

[2] BETTS, M. C., and MILLER, T. A. H. SMALL CONCRETE CONSTRUCTION ON THE FARM. U. S. Dept. Agr. Farmers' Bul. 1480, 38 p., illus. 1926.

eral directions to aid in the removal of water should it chance to enter. A trapped floor drain is sometimes employed for this purpose and is useful when draining washing machines and heaters and scrubbing floors. If a floor drain is installed, the floor should slope slightly from all directions toward it. Generally a floor drain is used infrequently, and the water in the trap evaporates, allowing drain air to enter the cellar. Therefore the installation of such a drain is not recommended unless there is frequent need for it.

(6) There should be a good ceiling of plaster on laths (preferably metal lath), plaster board, or other suitable insulation.

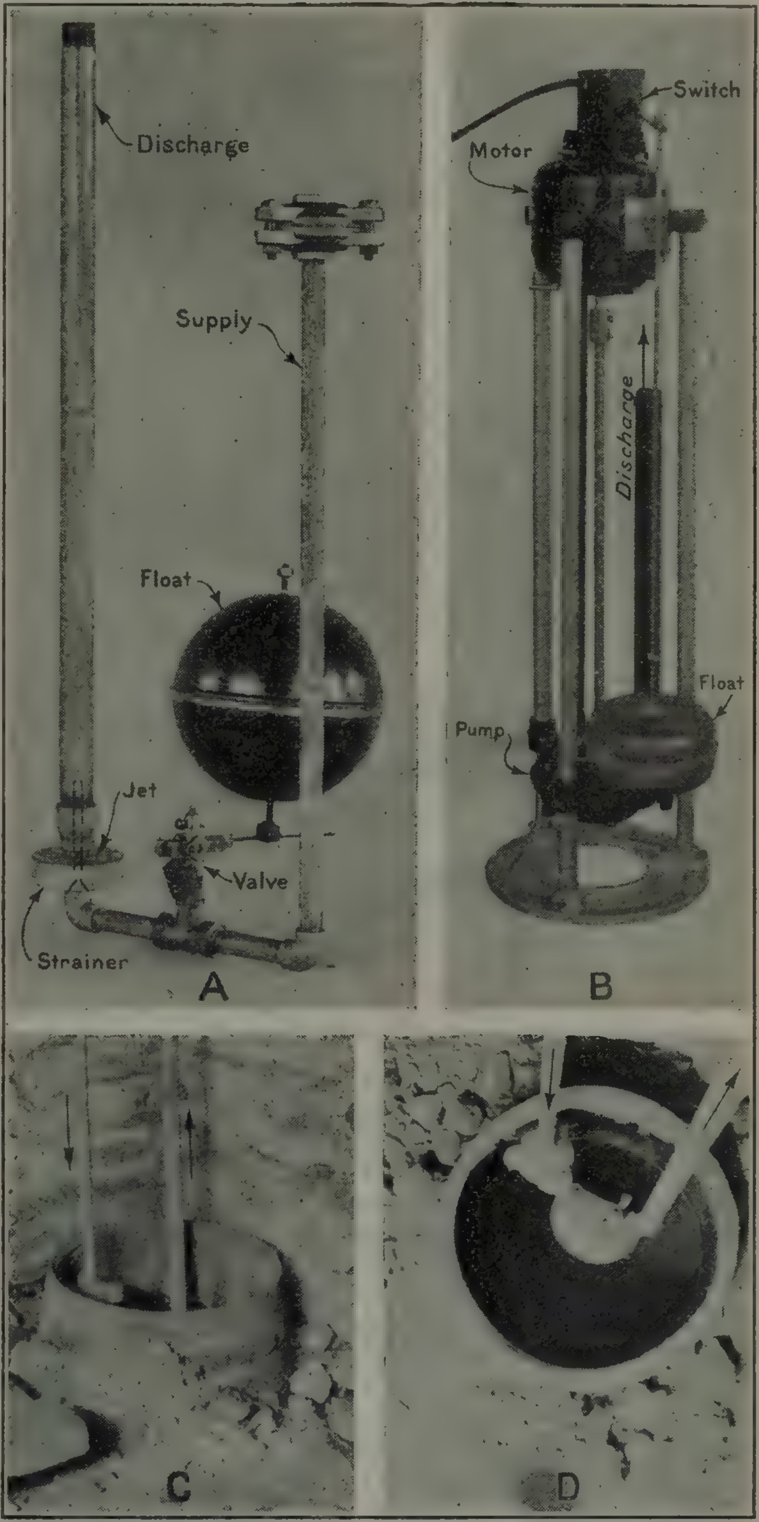

FIGURE 9.—Automatic cellar drainers: A, Main parts of a float-controlled hydraulic drainer; B, main parts of a float-controlled electric drainer; C, wooden barrel containing a hydraulic drainer in use 18 years, Maryland; D, looking into barrel from above; drainer cost approximately $12; including pipe and labor the installation cost $25

WATER-TIGHT CONSTRUCTION

Where a cellar floor is below the ground-water level and the water can not be lowered by drainage, water-tight construction is required. Concrete is generally preferred, and one of of the following two methods of water-proofing is commonly employed:

(1) Integral method, or dependence on close, compact construction of the wall itself.

(2) Membrane method, or use of a specially prepared felt, cotton drilling, or other approved fabric put down in overlapping layers, coated and cemented together with hot coal-tar pitch or asphalt, the

whole forming, or intended to form, a virtually water-tight box in which the main walls and floor are placed.

INTEGRAL METHOD

A considerable number of farmers do concrete work that is water-tight. Asked their secret, they are likely to say they "put in a little extra cement." Although richness of mix is important it is only a small part of the story. In addition, water-tight concrete requires good sand and stone and first-class workmanship in mixing, placing, and curing the product. Furthermore, the best concrete may avail little if leakage occurs at construction joints, at seams between successive layers or successive days' work or at cracks caused by settlement, shrinkage, or expansion. It is well known that concrete contracts slightly with drying or cold and expands slightly with wetting or heat.

Water-tight concrete is briefly treated in Farmers' Bulletin 1279 F,[3] referred to on page 12. Additional suggestions for obtaining the desired results are as follows:

(1) The work should be done in mild, dry weather, preferably in the fall because the ground water is likely to be low and air temperatures, approximating 50° to 60° F., are favorable to the making of water-tight concrete. Where newly placed concrete would be subjected to water under pressure the water should be removed by pumping or bailing. A spring beneath a floor or seepage against a wall can seldom be smothered with fresh concrete.

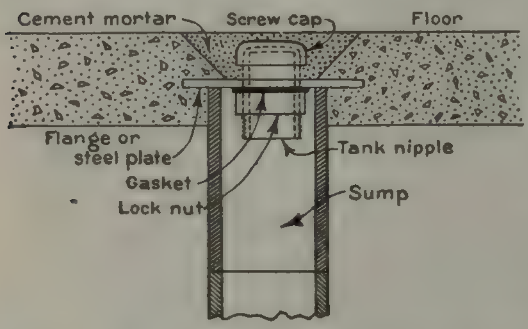

FIGURE 10.—Pump hole in a concrete floor

(2) Where a pump hole or sump must be floored over it should be constructed of one or two lengths of 6-inch draintile with a large flange or steel plate screwed to a tank nipple and embedded in the concrete as shown in Figure 10. The nipple should be sufficiently large to pass the suction pipe into the sump. When the floor is completed and pumping is discontinued, the top of the nipple is tightly closed with a screw cap, and the hole is filled with cement mortar, or concrete.

(3) Concrete should be mixed long and thoroughly, fresh Portland cement, clean coarse sand, clean sound stone not exceeding three-fourths inch in diameter, and the smallest quantity of water that will give a plastic, sticky, smooth-working mixture being employed.

(4) Concrete should be placed in as nearly a continuous operation as possible to lessen the number of construction joints and seams. The concrete should be spaded no more than is necessary to avoid a honeycombed condition. (See fig. 2.) Too much working brings the cement to the surface and injures the uniformity of the concrete. If work must stop before a wall has been built above high-water level a continuous groove or keyway should be formed along the

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[3] MILLER, T. A. H. Op. cit.

top center of the last layer by pressing beveled 3 by 3 inch scantling, narrow side down, into the fresh concrete.

(5) Thorough protection and curing of newly placed concrete are vital to water-tightness. Immediately after placing, it should be protected from freezing or rapid drying by sun or wind, all of which injure concrete and may make it worthless. As soon as the concrete is sufficiently hard, so that the cement will not wash away, it should be drenched and kept continuously and thoroughly wet for two weeks. An occasional sprinkling is insufficient. Curing by complete submergence is very desirable. Although walls can seldom be treated in this way in most instances it is feasible to pond the whole floor. Walls are more conveniently cured by covering them with bagging, hay, or straw weighted down and kept thoroughly wet.

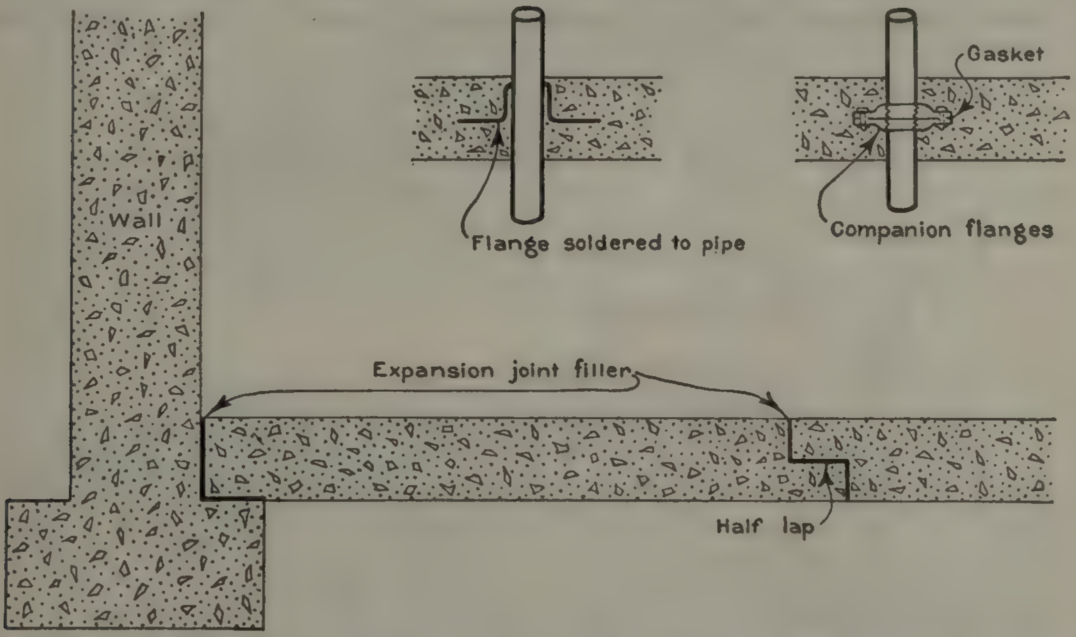

FIGURE 11.—Water-tight construction: Floor laid with expansion joints and in alternate squares not exceeding 10 feet on a side; pipes through floor or wall provided with tight flanges of a diameter two or three times the external diameter of the pipe

(6) Where there is considerable water pressure or wide variation of cellar temperature, the need for steel reinforcement should be considered. If the ground water never rises more than a foot above the under side of a concrete floor 5 inches thick, steel reinforcement may not be necessary, as such a floor has sufficient weight to resist the upward pressure of the water. If such a cellar is heated in winter and is kept reasonably cool in summer, the temperature range of the ground under the floor seldom exceeds 20°, and visible cracks rarely form, provided the concrete work is first class and especially if it has been cured under water. It is safer, however, to provide for expansion and contraction by some one of the following methods, and this should always be done where the temperature may range from near the freezing point in winter to 70° or 80° F. in summer.

The usual method is to lay the floor in alternate squares not exceeding 10 feet on a side. Just before laying the intervening squares, a brush priming coat followed by a heavy coat of hot asphalt or hot coal-tar pitch spread with a mop is applied to the clean dry edges of the squares and any abutting wall. Half-lap joints, shown in

Figure 11, further contribute to water-tightness. Expansion joints are also made with manufactured cushion strips of fiber matrix and bitumen the full depth of the joint, or by the use of a collapsible form, or a strip of smooth, well-greased board, to create a thin open joint which is afterwards filled with hot bituminous compound or mastic. A mixture of three parts of dry clay and one part of melted paraffin has also been used for joint filling. All pipes through the floor should be fitted with tight flanges or collars to be embedded in the concrete, as shown in Figure 11. Even an ordinary screw coupling is of value in preventing water from following along the outside of a pipe.

Sometimes, instead of laying the floor in squares, an unbroken reinforced concrete slab is laid, as illustrated in Figure 12. After the footing course and any necessary post foundations are laid, the floor is constructed with a 3 by 3 inch beveled keyway along the center line of the wall, as shown in Figure 12 and as explained on page 14. Thus a tongue-and-groove effect is obtained which insures water-tightness between floor and wall, ordinarily the weak place. The reinforcement should be not less than ¼-inch round bars spaced 15 inches apart each way, requiring about 27 pounds of steel for 100 square feet of floor.

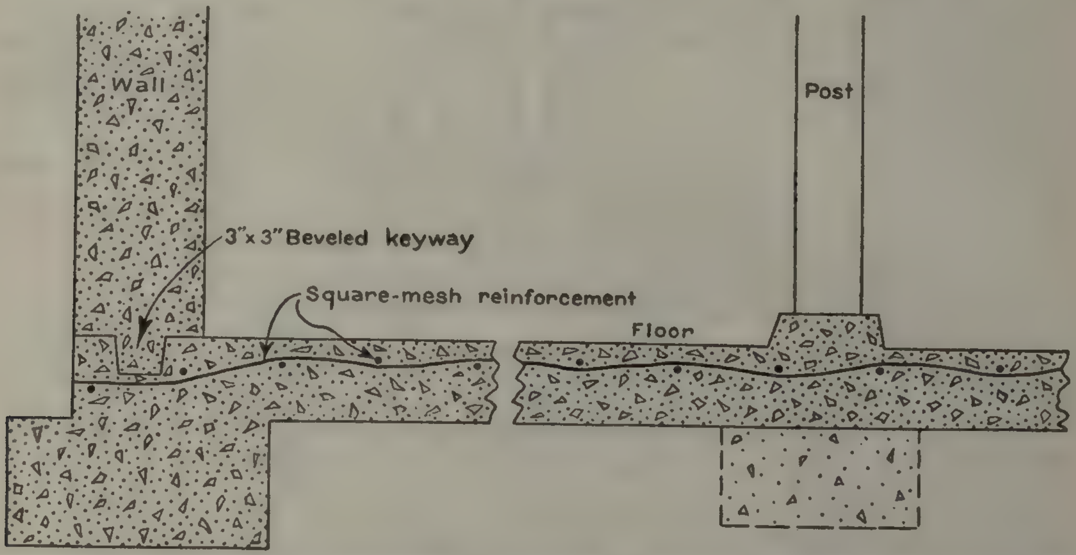

FIGURE 12.—Water-tight construction: Reinforced concrete floor with beveled keyway interlocking wall and floor

Standard wire-mesh reinforcement or expanded metal may be used instead of bars. A standard electrically welded square-mesh fabric composed of No. 8 gage wire spaced 6 inches apart each way approximates 30 pounds per 100 square feet and can be obtained in rolls of different lengths and widths as desired. A smooth, even 3½ or 4 inch base course should be laid in strips slightly wider than the roll, and the wire fabric, with all bulges hammered flat, should immediately be rolled upon and slightly pressed into the fresh concrete. The several strips of fabric are usually lapped about one mesh; an end lap, if needed, should also be one mesh. The top course of concrete should be promptly placed in the usual manner.

A 5-inch floor, stiffened as above described and carrying ordinary wall and column loads at intervals of 10 to 12 feet, is safe against uplift where the ground-water level or head is 16 to 18 inches above the under side of the floor. For larger spans or higher heads the floor may need to be thicker and the steel heavier. Such construction should be designed and built to meet the requirements of each case.

MEMBRANE METHOD

The membrane method of waterproofing and damp-proofing concrete, brick, tile, or stone work consists of laying overlapping layers of a prepared waterproofing fabric and thoroughly coating and bonding every lap with hot asphalt or hot coal-tar pitch. The masonry itself may be leaky, but water-tightness is obtained by the coated fabric or membrane, which is laid through and around the masonry and virtually constitutes a turned-up mat or box outside of the main walls and floor. The method is reliable when the work is done by experienced men, and the ordinary individual by closely following instructions can do a reasonably good job. Where it is impossible to secure local labor experienced in cutting and applying membrane waterproofing, sketches, specifications, and explicit directions should be obtained from a reliable manufacturer whose materials are to be used. It is advisable to experiment with the materials on a small upright surface before attempting the actual work. The method is not cheap, and if leaks do develop they may be difficult to locate and costly to repair.

The materials and principal tools for home work are shown in Figure 13. The fabric generally used is a wool-and-cotton rag felt impregnated with asphaltic or coal-tar pitch saturating ingredients. The felt should be free of holes, rents, cracks, indentations, or ragged edges. Asphalt and coal-tar pitch in solid form are shipped in wooden barrels or steel drums. The compound as received from the manufacturer should be cut into small lumps with an ax and heated to about 300° F. in a kettle out of doors. Care should be used to avoid overheating which may make it brittle when cold and destroy its cementing properties. When the compound is fully melted and of uniform consistency it is an even glossy black. It should always be used when in this hot liquid condition and the mopping should be done rapidly.

The surface to which the felt is to be applied should be smooth, dry, and clean. Warm weather greatly favors the work. Brickwork should have struck joints, and holes and depressions in concrete or other masonry should be filled with Portland-cement mortar. Projecting stones or bits of mortar that might puncture the felt should be knocked off, and very sharp edges should be slightly rounded.

Figure 14 shows the membrane method as generally applied in new construction. After the footing course is placed and the bottom of the excavation is compacted and smoothed a 1-inch underbed of cement mortar or, if the conditions are severe, a thin underbed of concrete should be evenly spread over the whole area to form a base upon which to lay the floor membrane. A 4-inch brick or concrete wall should then be built to such height as the conditions require to form a backing for the wall membrane. The floor and wall membrane should be laid as a unit. Each strip of felt, lapped and coated with the hot compound, should be laid across the floor and be continued without break at the wall angle up the inner face of the 4-inch veneer wall. After completion of the membrane a ¾-inch protecting layer of cement mortar should be spread over the whole floor area, and this should be covered with a 4 or 5 inch concrete floor recessed along the edge to lap and bond with the side wall, as shown. The main wall should be built close to or against the membrane, and all space between the wall and the membrane should be solidly filled, by pouring, with the hot compound or with Portland-cement grout.

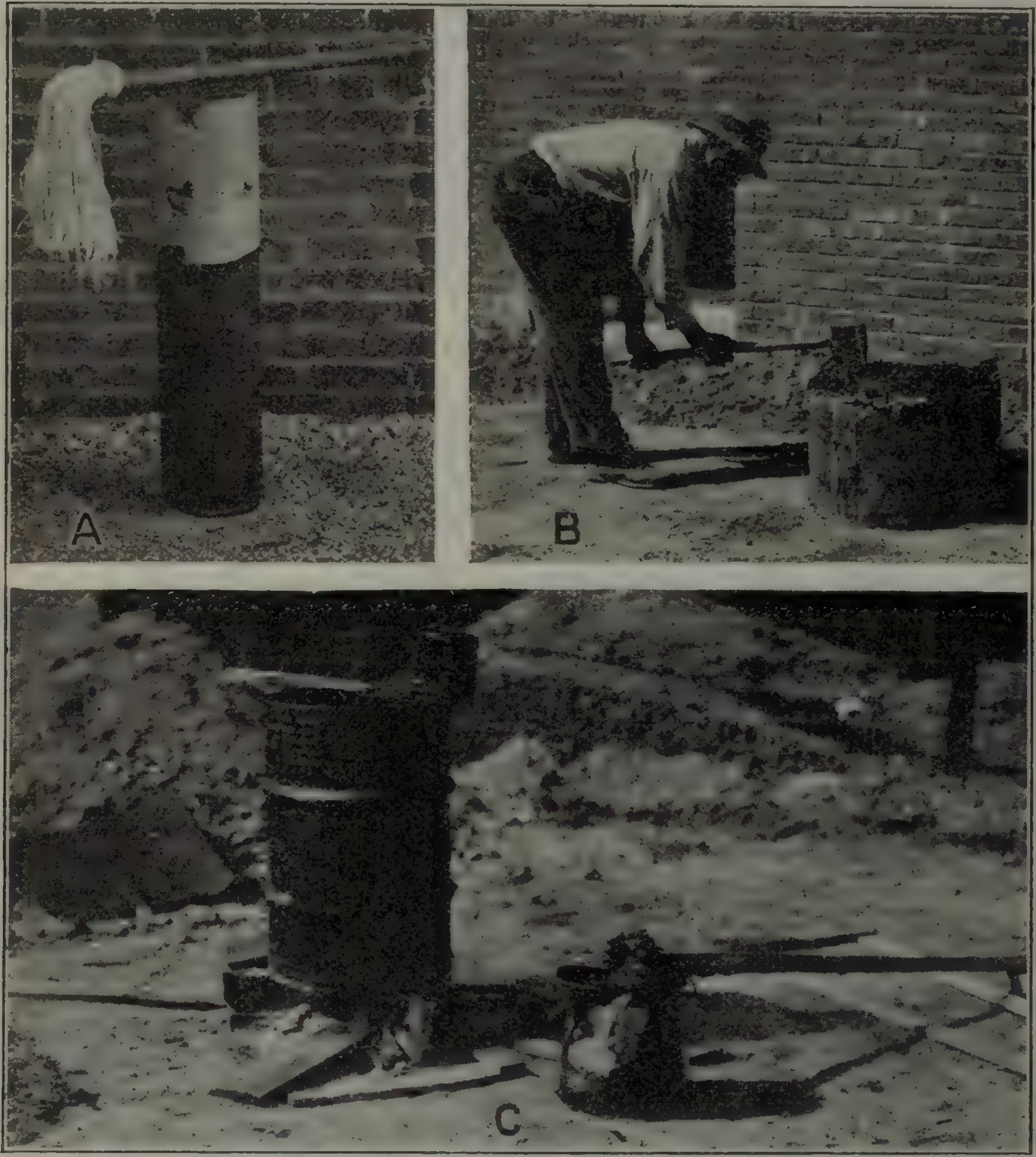

FIGURE 13.—Materials and tools for membrane waterproofing: A, Roll of felt and homemade cord mop; B, cutting the compound into small lumps; C, heating kettle consisting of an old 42-gallon gasoline drum set 6 inches from the ground on bricks and fired with wood

Where it is not possible to waterproof the floor and wall in one operation especial care is necessary so that later the strips of felt may be properly interlapped and interlocked. Usually, if the walls are constructed first, a 12-inch strip of the cement underbed is laid along the footing course, and the wall membrane is brought down and over the footing course and underbed leaving a 6 to 12 inch length of each strip of felt lying flat, and uncoated with compound, on the underbed. When the floor membrane is laid the uncoated laps are turned up, coated with hot compound, and interlocked with the floor sheets. Pending the main floor work, the membrane already placed, including the dry laps, should be covered with a waster sheet of dry felt and a thin protective coat of lean cement mortar. This covering is temporary and is removed when the floor membrane is laid, its purpose being to prevent injury to the felt by wheelbarrows, tools, or careless workmen.

The number of layers of felt which may be needed vary with the drainage conditions and the ends to be attained. Two layers of felt are generally sufficient where there is little or no head and the main purpose is to damp-proof. From three to five layers, depending on the height of the ground water are advisable for real waterproofing jobs.

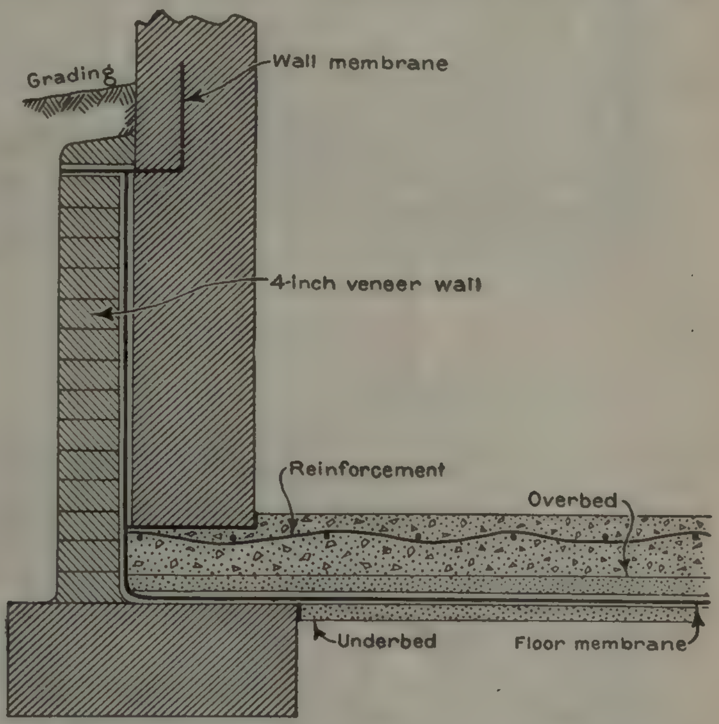

FIGURE 14.—Recommended application of membrane waterproofing

Figure 15 shows how the felt may be run and lapped in two-layer and three-layer work. End laps should overlap at least 6 inches. Each and every lap should be fully and evenly mopped with the hot compound, and the felt, closely following the mop, should be unrolled into the hot coating. This process, a strip at a time, is continued until every part of the surface to be treated has the required number of layers thoroughly cemented together.

With the intention of avoiding any seepage seam between the felt and the masonry, the two are sometimes united and bonded as effectively as possible, and in ordinary cellar work this is probably the better practice. For this purpose the masonry should first be given a suitable penetrating priming or bonding brush coat, applied cold, of about 1 gallon per 100 square feet. The use of a large, flat-bristle brush or a three-knot roof brush with long handle expedites the work. Without the priming coat the hot compound is unlikely to stick strongly to the masonry because of quick chilling and slight penetration, and the bond will be especially poor if the masonry is damp or cold. As soon as the priming coat sets, the surface should be mopped with hot compound, the felt being rolled into it as previously described.

The felt should lie perfectly smooth. Wrinkles and buckles should be smoothed out, and the sheets should be carefully pressed down

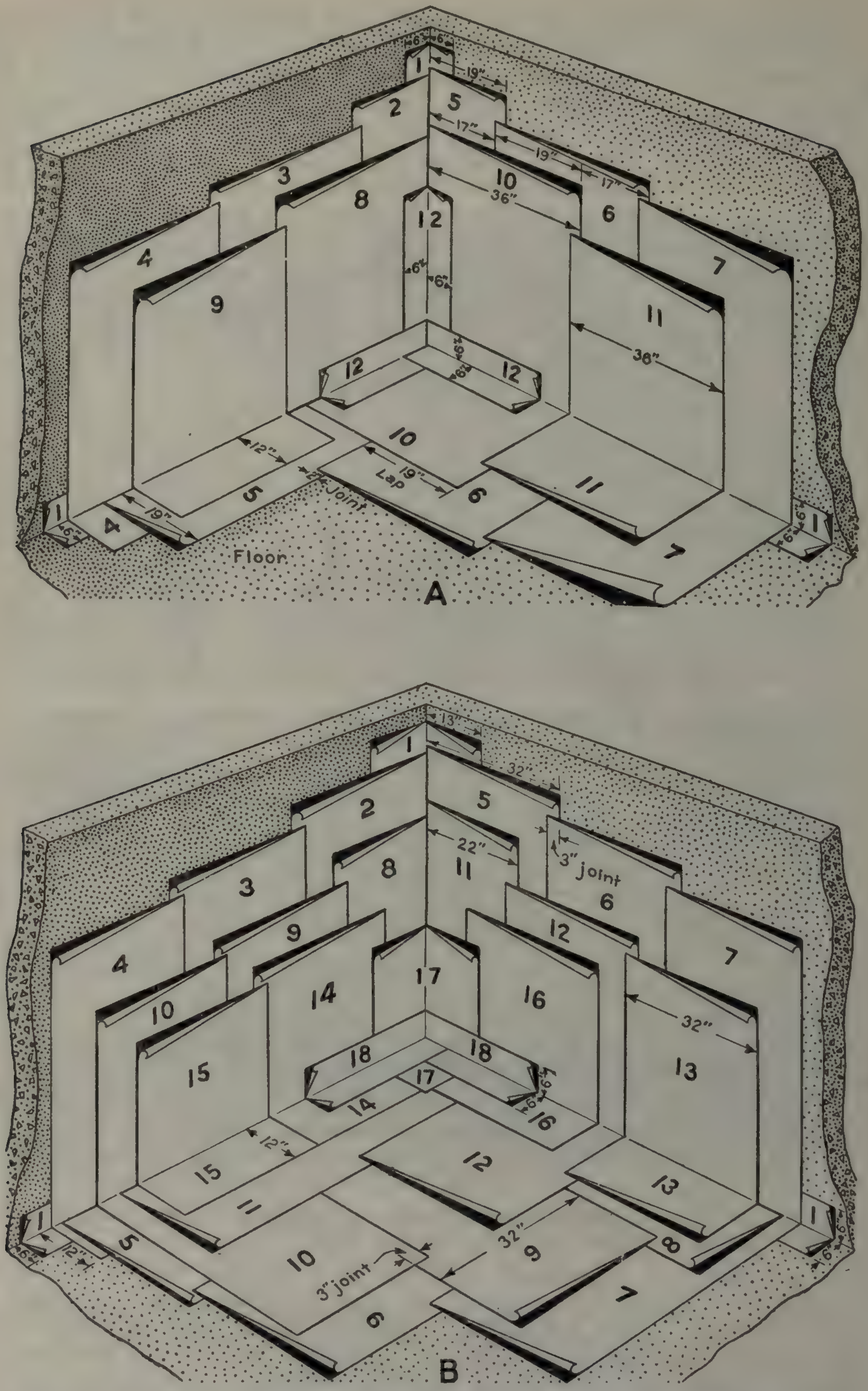

FIGURE 15.—Membrane waterproofing: A, Two layers of 36-inch felt, spaced 17 inches, overlapped 19 inches, jointed 2 inches; numbers show order of applying sheets. B, three layers of 32-inch felt, jointed 3 inches; intermediate floor layer crosswise of bottom and upper layers; wall sheets overlapped 22 inches, spaced 10 inches

and rubbed with the hand to remove air bubbles and to insure perfect bond between felt and felt. Special care is required to make the felt fit corners and angles neatly and snugly. To reinforce such places two strips of felt, cut to extend at least 6 inches each way from the angle, may be applied one strip before and one strip after placing the main waterproofing. After the several layers of felt have been cemented together the entire surface should be given a heavy mop coat of the hot compound. Five gallons per 100 square feet gives a top coating approximately five sixty-fourths inch thick. Each coat between layers of felt takes about 3 gallons per 100 square feet, and the mop coat over the primer on the masonry takes about 6 gallons per 100 square feet, making a total of 17 gallons of compound per 100 square feet for three-layer work and 14 gallons for two-layer work.

Thus there is built up a water-tight, more or less pliable, yielding blanket or membrane approximately one-third inch thick in three-layer work and one-fourth inch thick in two-layer work. Figures 16 and 17 show waterproofing work in progress, the views being arranged in the order in which the work is usually prosecuted.

PLASTER COATS

PORTLAND-CEMENT MORTAR

Plaster coats of Portland-cement mortar have been much used to waterproof and damp-proof cellars. Sometimes the results have been successful and sometimes disappointing. Much that has been said regarding the mixing, bonding, placing, and curing of concrete is equally true of mortar. Many failures with cement plaster are due to the sand being too fine or too coarse, too much water in the mix, plastering against seepage, poor preparation of the old surface, or poor bond between successive coats. Patches sag or slough off while the mortar is soft or scale off when it is hard. In other instances contraction cracks form, but this tendency may be partially offset by long wet curing of the plaster. Success is more likely to be obtained by employing skilled plasterers working in practically continuous operation so as to lessen the amount of joint work.

The surface to be plastered should be rough, thoroughly clean, and moist but not dripping. It should be kept wet by drenching with clean water for several hours prior to the application of the plaster. A dry surface will absorb moisture from the plaster and so prevent its proper setting and bonding. Just before the plaster is applied the moist surface should be given a brush coat of neat Portland-cement grout. Each plaster coat should be applied before the coat beneath sets hard so that all will knit or bond together. Each under coat should be lightly scratched or scored with a sawtooth paddle, piece of metal lath, or sharp stick, checkerboardlike, thus improving the mechanical bond with the next coat. All coats except the last on the outside of walls should be well worked with a wooden float to make the surface slightly granular. A steel trowel should be used on an outside finish coat because it produces a smooth impervious surface, but overworking should be avoided as it creates a rich surface skin liable to crack badly and scale off.

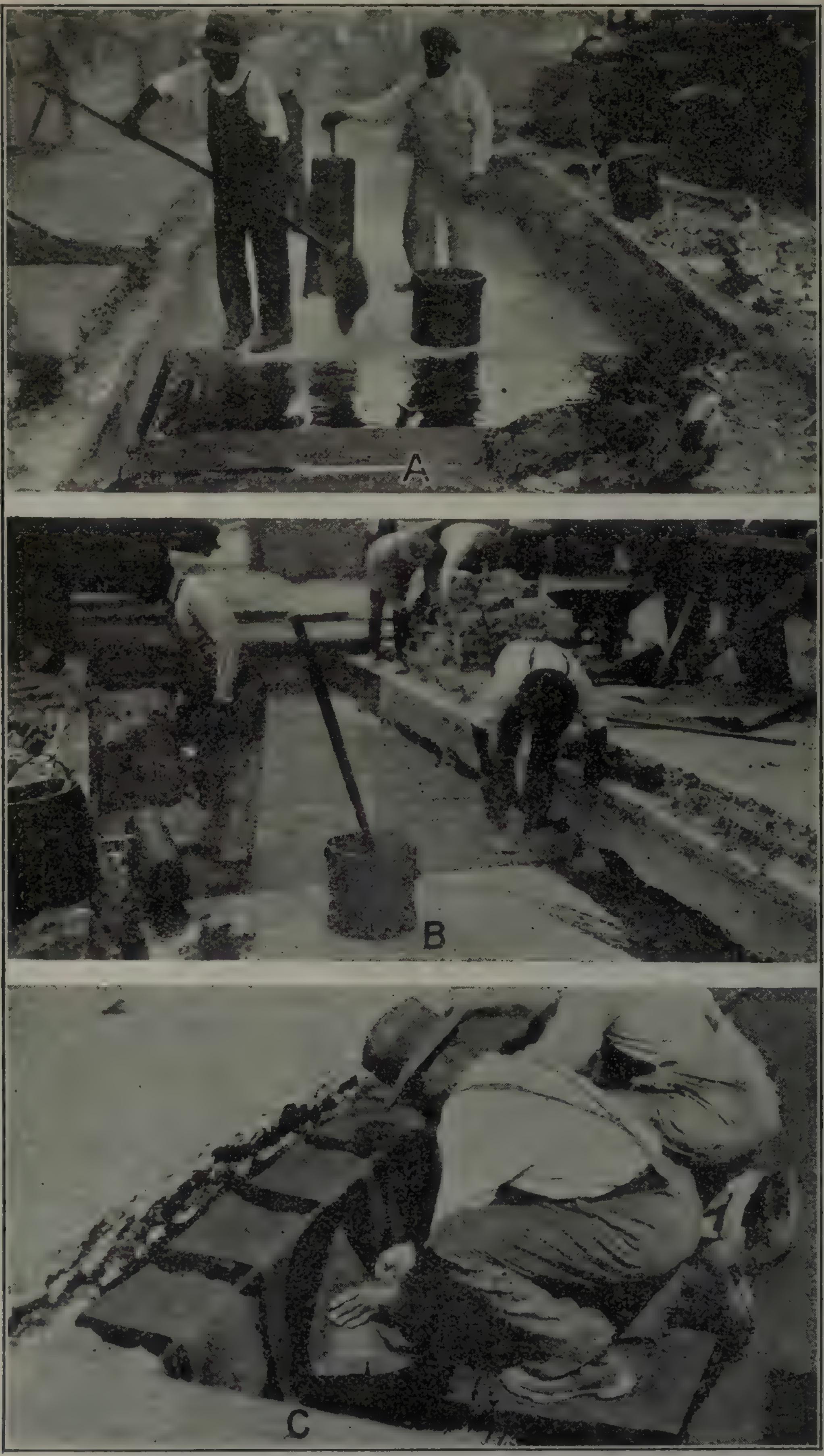

FIGURE 16.—Membrane waterproofing: A, Applying mop coat to masonry; B, rolling the felt after the mop; C, cutting felt to fit around an obstruction

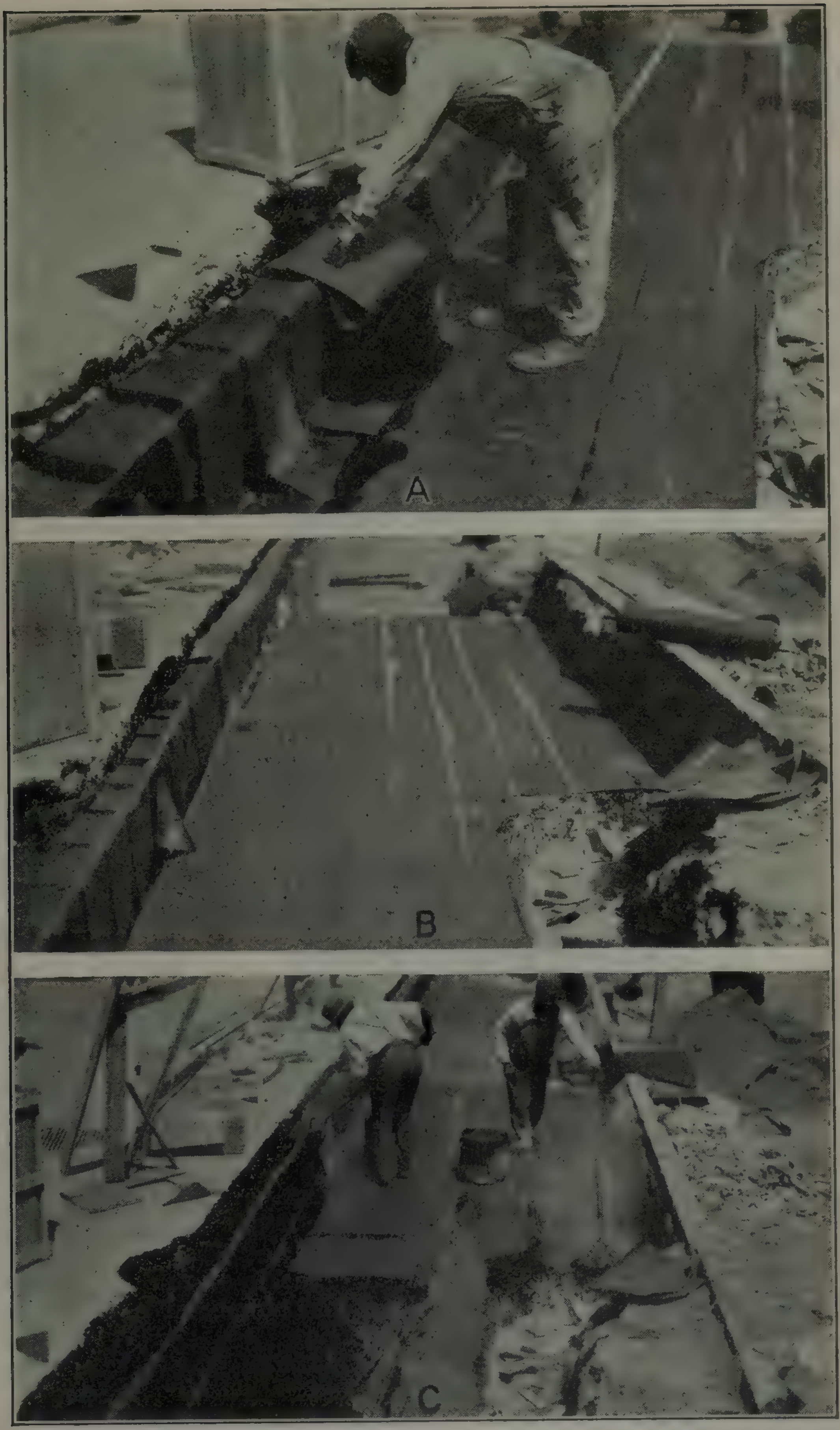

FIGURE 17.—Membrane waterproofing: A, Cutting and applying vertical sheets to lap about a foot on the floor sheet; B, a completed layer with felt thoroughly stuck to felt; C, applying the heavy top-mop coat

Floor plaster is usually applied in one coat about three-fourths inch thick. Wall plaster is applied in two or more coats each about three-eighths inch thick. A slight saving can generally be effected by making wall plaster a little thinner at the top than at the bottom. Damp-proofing plasterwork generally approximates three-fourths inch in thickness. Waterproofing plasterwork on the inside of walls generally tapers from 1½ to 2 inches in thickness at the bottom to three-fourths inch at the top. Waterproofing plasterwork on a floor liable to pressure from beneath should be underlaid with a properly reinforced layer of concrete from 2 to 4 inches thick, as described on pages 15 to 17.

Joints, angles, and corners are the weak places. There should be as few joints as possible, and they should be made on the wall or on the floor a foot or more from angle or corner. All angles and corners should be coved or rounded as a continuous part of the plastering. If the floor is to be plastered first and the walls must wait, the plastering should be carried up the walls about a foot, leaving a rough beveled edge which is later wet, brush coated with grout, and bonded with the wall plaster. Wall plastering should be started by making a rough vertical beveled edge on the flat surface, as it is difficult to make a tight closure at a corner. The plastering should be completed with as few vertical joints as possible. If the walls are done first, the plastering should be carried out on the floor about a foot, leaving a rough beveled edge to be grouted and bonded with the floor plaster. The latter method (walls first) is usually more convenient, but the first method (floor first) is more likely to give a water-tight job because the joint work is at a higher level. Plastering dries quickly and may crack. Just as soon as it is sufficiently hard, so that the cement will not be washed away, it should be drenched and kept continuously wet or flooded for at least a week.

BITUMINOUS-PLASTER COATS

Commercial bituminous mortars applied cold with a plasterer's trowel are used to damp-proof and to intercept shallow seepage. These plastic cements are usually asphalt or other bituminous material combined with asbestos fiber, mineral filler, and suitable volatile solvents. It is advisable before using such products to obtain explicit directions and specifications from the dealer or manufacturer.

The cement, ready for use, comes in containers holding from 30 to 500 or more pounds. It should spread smoothly and evenly, without drawing or pulling. A ⅛-inch coat requiring approximately 80 pounds for 100 square feet is usually applied to the outside of cellar walls and a ¼-inch coat to cellar floors. The wall excavation may be refilled after the plaster has dried 24 to 48 hours, care being taken not to injure it. Floor plaster should be given a heavy protective covering of Portland-cement mortar or concrete.

DAMP-PROOFING MOP AND BRUSH COATS

A common way of damp-proofing a cellar wall or floor is to mop coat the surface with hot coal-tar pitch or asphalt or to brush coat with a cold prepared bituminous or other water-repellant paint, as shown in Figure 18. Although this method has considerable waterproofing value and is very useful for shedding seepage down the outside of a wall, it lacks the durability and effectiveness of a good felt membrane. In all instances the surface to be treated should be well prepared, as described on page 17. Paint coats require especially well-plugged, smooth, clean, dry surfaces. The last floor coat should generally be protected by a good layer of Portland-cement mortar or concrete. The last coat on the inner side of walls should be whitewashed, painted with Portland-cement grout, or given a Portland-cement plaster coat or other slightly granular finish.

HOT COAL-TAR PITCH OR ASPHALT

The preparation and application of these materials have been explained on pages 17 to 21. Particular care should be taken in applying the priming coat to cover all spots and to fill all pores, hair cracks, or other small cavities. As soon as the primer sets, the surface should be given a heavy mop coat of the hot compound. When this coat is hard another mop coat should be applied and thoroughly swabbed so as to fill and cover any pinholes or thin spots in the first. Mopping on walls should proceed from the top downward and sideways.

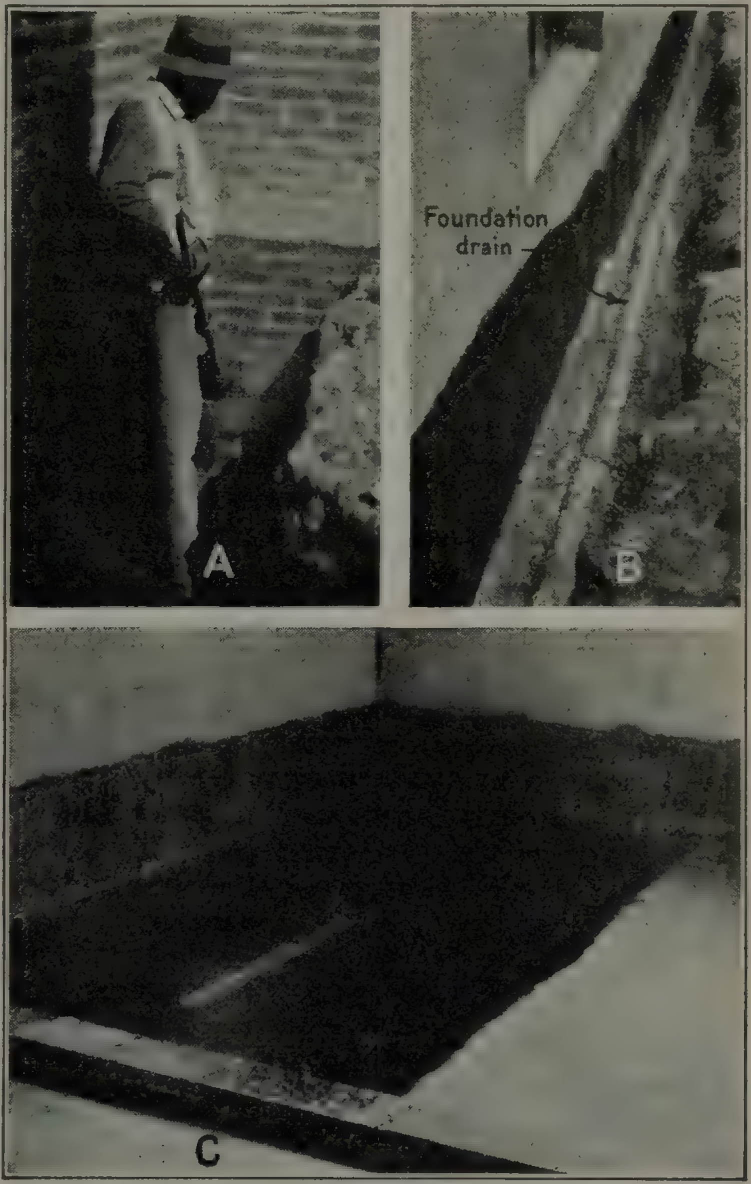

FIGURE 18.—Damp-proofing coatings: A, Applying a mop coat of hot bituminous compound to the outside of a cellar wall; B, wall below grading painted with four coats of thin water-gas tar and a seal coat of fluxed, refined coal tar; C, one panel of a basement floor and wall treated as is the wall in B, except that the light area has no seal coat

PREPARED BITUMINOUS PAINT

Commercial bituminous paints are used for strictly damp-proofing purposes. The paint is applied cold with an ordinary paint brush and in at least two coats. The primer should be very thin and should be thoroughly brushed into all pores and minute cracks. It is usually applied at the rate of 1 to 1½ gallons per 100 square feet, but the quantity will vary with the porosity and roughness of the surface. Within 24 hours the second coat is applied at the rate of 1 gallon per 100 square feet, giving a film approximately one sixty-fourth inch thick. Each additional coat of 1 gallon per 100 square feet will increase the thickness of the layer about one sixty-fourth inch. Earth back-filling may be done 24 hours after the application of the last coat, care being taken not to bruise or scar the paint.

WATER-GAS TAR AND COAL TAR

Water-gas tar and coal tar, obtainable at city gas works or from manufacturers of roofing materials, have proved effective for damp-proofing. Four coats of very thin water-gas tar, requiring about 2½ gallons per 100 square feet of masonry, are applied cold with a brush or spray. Sufficient time should be allowed between coats for each to be absorbed by the masonry. After the last coat is dry and when the air temperature is about 80° a seal coat of cold-fluxed refined coal tar is applied at the rate of ½ to 1 gallon per 100 square feet and thoroughly brushed in. Outdoor work generally dries in 24 to 48 hours. Indoor work may require more time. Examples of this treatment are shown in Figure 18.

HOMEMADE PAINT

A good, homemade damp-proofing paint can be prepared by dissolving paraffin in gasoline or kerosene warmed to 80°. Several coats of a 10 to 20 per cent solution (¾ to 1½ pounds of paraffin per gallon of gasoline) are usually applied. The lighter solution is perhaps better for compact natural stone and the heavier for brick or concrete. Work of this kind should be done only where there is free ventilation, natural or electric light, and no fire.

IMPROVEMENT OF OLD CELLARS

Making old cellars water-tight and damp-proof is usually more difficult and costly than making new construction water-tight and damp-proof. Where it is desired to damp-proof or shed water down the back of a wall, outside work is more effective than inside work, but it necessitates the excavating of a work trench two or more feet wide. If outside work is decided upon the desirability of a foundation drain (see fig. 8) should not be overlooked.

It is sometimes inadvisable to dig a trench along the outside of a foundation because of the expense or the presence of trees or shrubbery. In such cases the tile, embedded in coarse gravel, is sometimes laid along the inside bottom of the foundation. The tile must lead to a drainage outlet and may be covered with the usual concrete floor. A drain thus located usually removes water pressure but is less effective than that shown in Figure 8 for protecting the outside and bottom of the wall and foundation.

Waterproofing is usually inside work. Damp-proofing is often applied inside because it is generally cheaper and causes less inconvenience than outside work. In general, work of this kind is done in a manner similar to that previously described for new construction of like character. The importance of properly preparing old surfaces should not be overlooked. All deep holes and depressions should be plugged with cement mortar, thus making it possible to apply plaster coats of fairly uniform thickness or to smooth the surface for brush or membrane work.

Cement plaster should never be applied to a dirty, dusty, or greasy surface. Paint, whitewash, and loose plaster should be removed. Cleaning is facilitated by the use of a wash composed of 1 part of muriatic acid and 5 to 10 parts of water. After a half hour the acid, dirt, and loose particles should be thoroughly washed off, preferably by flushing with a hose and scrubbing with a wire or stiff bristle brush. Smooth surfaces should be roughened by hacking with a peen hammer, old ax, or pick. Sometimes holes are punched in old floors to key the plaster securely. The joints of brick or stone masonry should be raked out to a depth of one-half inch. A groove is sometimes cut in seepage cracks and filled with well-tamped jute, oakum, or mortar, but it is generally advisable not to attempt plastering work when there is seepage from beneath or outside.

Furnaces, boilers, pipes, or woodwork which would break the continuity of plaster waterproofing coats should be temporarily removed. Where water may follow up the outside of a steel or iron post and the post can not conveniently be fitted with a tight flange or collar to be puddled into the floor, an expansion joint should be made around and against the post and should be filled with bituminous compound, as described on page 16.

CONDENSATION AND VENTILATION

It is unwise to spend money for waterproofing or damp-proofing work while there is possibility that the trouble is due to condensation of atmospheric moisture or to some more or less easily corrected minor cause. Leaky plumbing should be repaired, and close overhanging vines, shrubbery, or trees, productive of very deep shade, should be pruned or thinned out. Sunlight and free movement of air are wonderful agencies for removing dampness and wetness.

Water vapor from calm air is deposited or condensed on a cold surface under certain conditions of relative temperature and moisture content of the air. The surface appears to sweat. Sweating in cellars is more likely to give trouble in hot, sultry weather than in cool or cold weather at which times the atmosphere is usually comparatively dry. Sweating may be very profuse if the underground conditions are such as to make the walls or floor unduly cold or if the surface has been made glossy and impervious by the application of a damp-proofing paint. Under very unfavorable conditions the lower part of cellar walls may drip, and shallow pools of water may gather on the floor, a condition frequently attributed to seepage from outside.

Sweating is not easily controlled. The most feasible remedy is well-regulated ventilation. Since the atmosphere, when cool, is normally drier than when warm, ventilation should be regulated by adjusting window and bulkhead openings in accordance with the weather conditions. Generally, where sweating gives trouble, windows and bulkheads should be open night and day during fair weather and when it is cooler outside than inside the cellar. During hot sticky weather or long rainy spells windows and bulkheads should be closed, because the outside air, at those times, is likely to be more moist than cellar air.

Screens should be provided to keep out mosquitoes, flies, and small animals. Examples of cellar screening are shown in Figure 19.

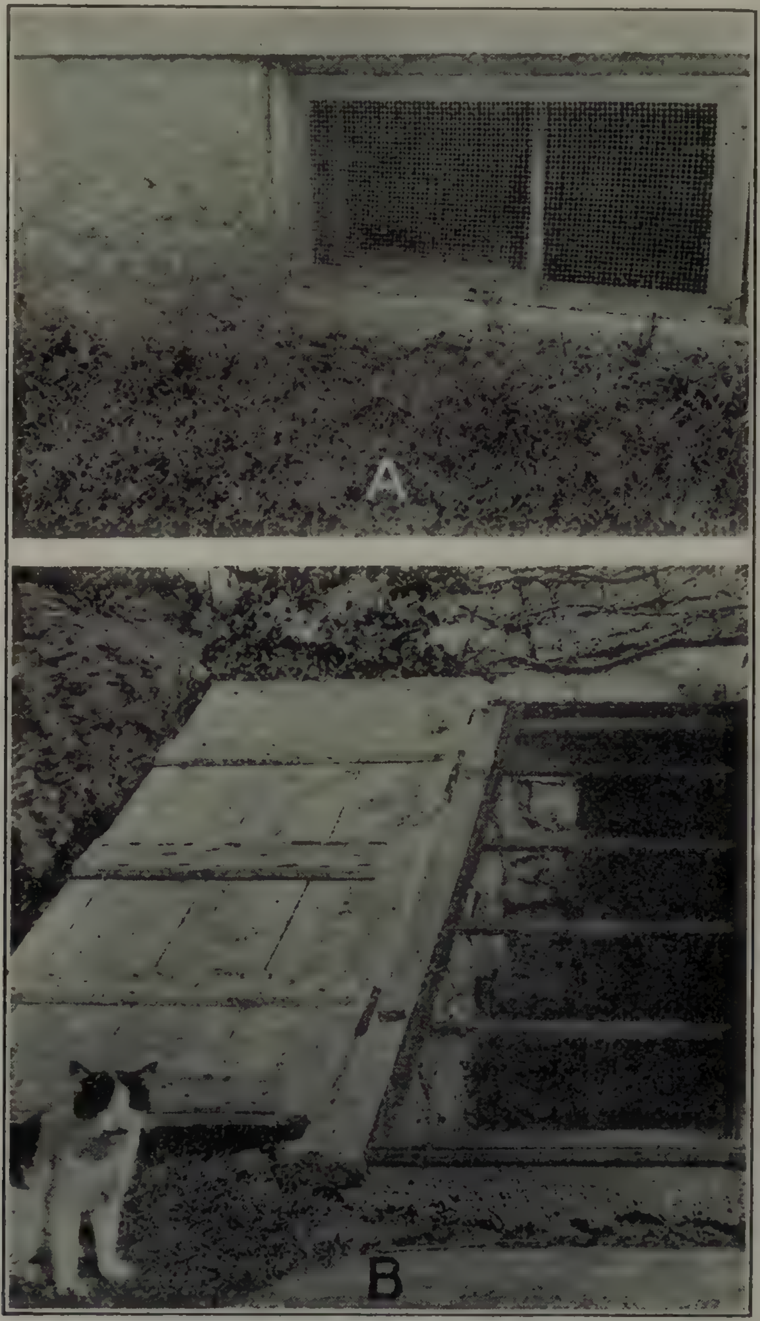

FIGURE 19.—Screened cellar openings. A, Screens having 4 meshes to an inch are common because they are strong and durable, but are too coarse to keep out flies; B, bulkhead nicely protected by a screen having 12 meshes to an inch

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July 3, 1929

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LEGUME HAYS *for* MILK PRODUCTION

AN ABUNDANCE of home-grown legume hay establishes a basis for an economical dairy ration.

Legumes are superior to other hays in palatability, in quantity and quality of the proteins furnished, and in content of lime. As a class they yield more nutrients per acre than do nonlegumes, and protein is obtained at a lower cost.

In spite of these facts, only 41 per cent of the hay grown in the United States is legume hay. In the North Central and North Atlantic States, which contain 66 per cent of all the dairy cows, the farmers grow 2 tons of nonlegume to 1 ton of legume hay.

Leafy, small-stemmed hay, cut before it is too mature and properly cured without being rained on is best.

Alfalfa hay is considered best for dairy cows, followed closely by clover and the annual legumes, such as soy beans and cowpeas.

Washington, D. C.

Issued October, 1928

LEGUME HAYS FOR MILK PRODUCTION

By J. R. Dawson, *Senior Dairy Husbandman, Dairy Cattle Breeding Investigations, Bureau of Dairy Industry*

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LEGUMES LONG KNOWN TO MANKIND

THE LEGUMES are among the oldest plants known to mankind. Their superior feeding qualities and great value as forage crops were recognized as early as the first century. At that time Columella, an early Roman agricultural writer, stated: "The best forage plants are alfalfa, fenugreek, and vetches. Alfalfa may be placed in the foremost rank of such plants; for when once sown it lasts 10 years, fattens lean cattle, and has a salutary action on sick cattle."

FIG. 1.—Raking alfalfa hay with side-delivery rake

In spite of the fact that Columella had the right idea nearly 2,000 years ago and that his recommendations have been uniformly confirmed and reconfirmed by all the careful hay investigations that have been carried out since, only 41 per cent of the hay grown in the United States at present is legume hay. Furthermore, in the North

Central and North Atlantic States, which contain 66 per cent of all the dairy cows in the country, the farmers grow 2 tons of nonlegume hay to 1 of legume hay.

COMPARISON OF LEGUME HAYS AND TIMOTHY IN YIELD OF PROTEIN AND OTHER NUTRIENTS

Table 1 shows that the legume hays, alfalfa and clover, produce more hay per acre than does timothy. Alfalfa averaged 2.79 tons of hay per acre during 1927; clover, 1.75 tons per acre; whereas timothy yielded only 1.43 tons per acre. An acre of average alfalfa hay in 1927 produced almost 7 times as much digestible protein, over twice as much total digestible nutrients, and 15 times as much lime as did timothy. In other words, it required approximately 7 acres of timothy hay to produce as much digestible crude protein as 1 acre of alfalfa. Fifteen acres of timothy would have to be grown, harvested, and fed to produce as much lime as 1 acre of alfalfa.

TABLE 1.—*Average yield per acre of various hays for the year 1927 and quantity of nutrients produced per acre*

Hay	Average yield per acre [1]	Digestible crude protein [2]	Total digestible nutrients [2]	Lime (CaO) [2]
	Pounds	*Pounds*	*Pounds*	*Pounds*
Alfalfa	5, 580	591	2, 879	108. 81
Clover	3, 500	266	1, 781	56. 00
Timothy	2, 860	86	1, 387	7. 15
Soy bean [3]	2, 180	255	1, 168	37. 49
Cowpea [3]	2, 180	285	1, 068	55. 37

[1] Average yields as reported by Bureau of Agricultural Economics, U. S. Department of Agriculture.
[2] Figures taken from Henry and Morrison, Feeds and Feeding.
[3] Yields reported as annual legumes, including soy beans, cowpeas, velvet beans, and peanut vines.

One acre of clover hay produced three times as much digestible protein as 1 acre of timothy hay and as much lime as 7.8 acres of timothy. The annual legumes, cowpeas, and soy beans, are almost equal to the clovers in the quantity of nutrients and lime produced. Where it does well, alfalfa hay is far superior to the other legumes, both as to yield and the quantity of nutrients produced per acre.

Dairy cows build their bodies and produce milk from the nutrients they obtain from their feed. It is a well-established principle of correct feeding that the roughage should have first consideration in planning a ration. The roughage that produces the most and the best nutrients per acre should be grown. The legume hays as a class, and especially alfalfa, yield more nutrients per acre than does timothy.

PROTEIN OBTAINED AT LOW COST THROUGH HOME-GROWN LEGUMES

Concentrates containing large quantities of protein are added to dairy-cow rations primarily to supply protein in which the farm-grown cereal grains and nonleguminous roughages are deficient. These high-protein concentrates usually must be purchased, in which case the cost per 100 pounds of digestible protein is usually higher than if a portion of this digestible protein were raised on the farm in the form of legume hays. Table 2 illustrates this point.

TABLE 2.—*Cost per 100 pounds of digestible protein*

Feed	Price per ton	Cost per 100 pounds crude digestible protein
Alfalfa hay [1]	$12.02	$5.66
Timothy hay [1]	11.31	18.85
Clover hay [1]	11.91	7.83
Linseed meal [2]	47.45	7.85
Cottonseed meal (43 per cent)	49.60	7.42

[1] Estimated price received by producers Dec. 15, 1927, as reported by Bureau of Agricultural Economics, U. S. Department of Agriculture, January, 1928.
[2] Monthly average price, December, 1927, Minneapolis.

From this table it is seen that at the prices listed 100 pounds of crude digestible protein in alfalfa hay costs $5.66, whereas from timothy hay the same amount of digestible protein costs $18.85. It would take approximately 3.5 tons of timothy hay costing $39.58 to furnish as much protein as 1 ton of alfalfa hay costing only $12. Even when compared with the high-protein concentrates, such as linseed meal and cottonseed meal, alfalfa compares favorably in cost per 100 pounds of crude digestible protein at the prices given.

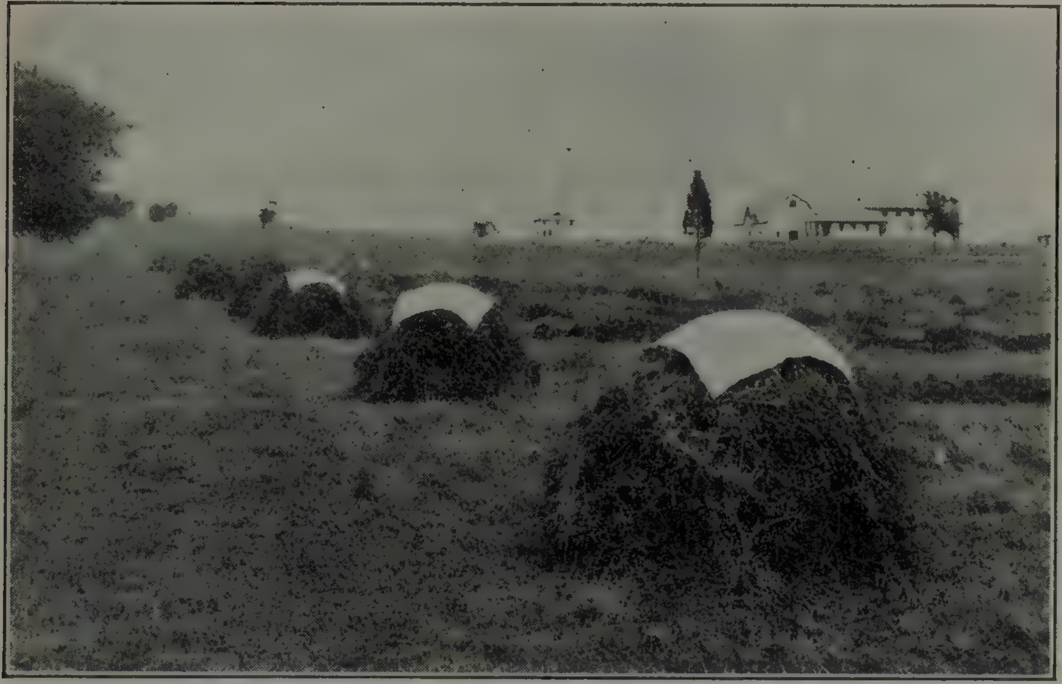

FIG. 2.—Curing alfalfa hay under canvas caps

If dairymen would grow and feed more protein in the form of legume hays, their feed bills would be reduced materially. An abundance of home-grown legume hay establishes a basis for an economical ration.

LEGUMES SUPERIOR IN PALATABILITY, IN QUALITY OF PROTEIN, AND IN CONTENT OF LIME

In addition to furnishing more milk-making nutrients at cheaper cost, the legumes are far superior to the nonlegumes in palatability. They are also superior in the quality of their protein and in the content of lime. The essential amino acids of the protein in legume hays supplement to good advantage the deficiency of amino acids in the cereal grains and silage.

As was previously pointed out, properly cured legume hays are much richer in lime than the nonlegume hays; alfalfa produces approximately 15 times as much lime per acre as does timothy. Experimental evidence shows that dairy cows, to produce at their best, must have a sufficient supply of available lime in their feed. Practically all the concentrates and the nonlegume hays are deficient in lime. The best way, therefore, to furnish a sufficient quantity of lime to dairy cows is to grow and to feed legume hays.

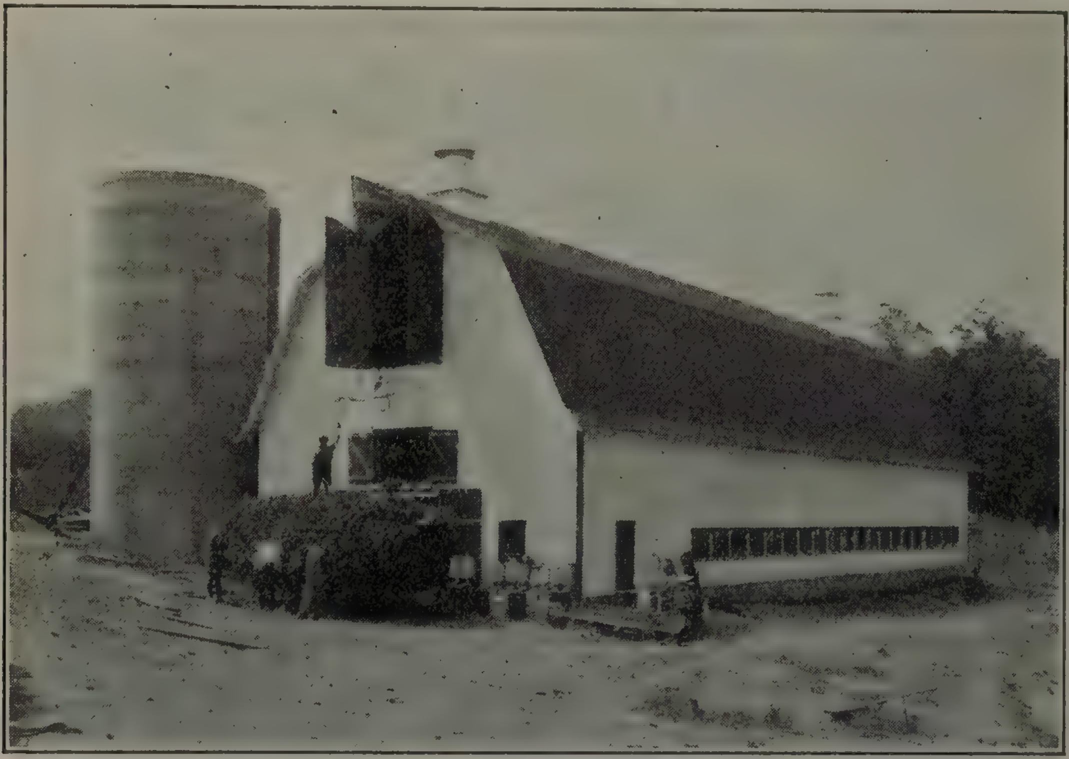

FIG. 3.—Putting legume hay in barn

WHICH LEGUMES ARE BEST?

There are many legumes which can be adapted to as many different conditions. Therefore, as a general rule, the legume that can be most practically produced on a given farm is the one that should receive first consideration.

Leafy, small-stemmed hay, cut before it is too mature, and properly cured without being rained on is best. In this condition it is most palatable and will contain a maximum quantity of its natural green color.

On account of its high protein and calcium content, its palatability, and greater yield per acre, alfalfa is considered the best legume hay for cows. In some irrigated sections of the West, where the alfalfa is low in price and of high quality, many dairy herds are profitably fed largely on alfalfa hay alone.

FIG. 4.—A field of red clover ready to cut for hay

All the clovers make good hay if cut at the proper stage and cured well. Most dairymen consider that clover hay is not quite equal in feeding value to alfalfa but that it is a close second. However, clover hay is more easily grown in some sections than alfalfa. Where this is the case clover may prove more practical.

FIG. 5.—Soy beans being grown for hay

The annual legumes, such as soy beans and cowpeas, are well liked by cows and furnish about the same amount of protein per ton as does alfalfa. As a rule, however, the stems are coarser, making them less palatable, and cows will waste more. Soy beans, cowpeas, and in some localities the vetches, are easily and quickly grown and can often be grown in an emergency as catch crops.

Sweet clover makes fine pasture; but it is not to be highly recommended as a hay crop because it is usually woody, stemmy, and unpalatable unless extreme care is used in cutting and curing. Cows often refuse sweet-clover hay at first and must be taught to eat it. Reports indicate that there is danger of poisoning when spoiled sweet-clover hay is fed.

FEEDING TRIALS

Experimental feeding trials where legume hays have been compared with the nonlegumes for milk production have invariably shown that the legumes produce more milk at less feed cost. Not only are the legumes efficient as milk producers, but they are almost indispensable in the proper feeding of dairy heifers. Their palatability and high protein and lime content make them especially valuable for growing animals.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1574

PREPARING JOHNSON HAY FOR MARKET

IN THE
BLACK PRAIRIE BELT
OF ALABAMA AND
MISSISSIPPI

PRODUCTION OF JOHNSON HAY is one of the leading farm enterprises of the Black Prairie Belt of Alabama and Mississippi. It is likely to remain an important enterprise, as it offers the most economical means of profitably utilizing extensive areas of land that are now occupied by Johnson grass.

Market conditions at present are far from satisfactory to Johnson-hay producers in this area. Decreasing demand and a wide price disparity between Johnson hay and timothy of comparable quality bring about a situation that is rather disheartening to farmers with whom the production of Johnson hay is a leading enterprise.

Too large a percentage of the Johnson hay now produced is of poor quality because of weather damage, the presence of weeds and trash, or the use of careless methods of curing, baling, and storing. The dumping of this low-grade hay on the market has resulted in such a prejudice against Johnson hay in some markets that there is no demand for even the best quality of the product.

A healthy demand for Johnson hay can be revived only by keeping low-grade hay off the market and by shipping hay of such quality as will meet the market requirements. Producers of Johnson hay must adopt methods of preparing their product for market that will enable them to produce a much larger percentage of quality hay if the enterprise is to be conducted on a profitable basis.

Production of quality hay can be increased by better management of meadows, by cutting at the proper time, and by more careful attention to proper methods of curing, baling, and storing.

Washington, D. C. Issued November, 1928

PREPARING JOHNSON HAY FOR MARKET IN THE BLACK PRAIRIE BELT OF ALABAMA AND MISSISSIPPI[1]

By M. A. Crosby, *Assistant Agricultural Economist, Division of Farm Management and Costs, Bureau of Agricultural Economics*

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INTRODUCTION

THE cotton sections of the South are generally lacking in perennial hay crops, and the principal consuming and distributing centers are largely dependent on outside producing sections for the bulk of their hay supply. This condition necessitates the shipping in of large quantities of hay from northern and western sections, and since most of this hay must be transported from a considerable distance, freight and handling charges add enormously to the ultimate cost to the consumer. It is obvious, therefore, that in such an extensive hay-deficit area there is inducement for increased hay production in those sections where it can be produced economically.

The Black Prairie Belt of Alabama and Mississippi is the only extensive hay-surplus area in the Southeastern States. Here Johnson grass is at present the most important hay crop. It thrives on the heavy clay soils and has gradually spread until in many sections it now occupies the land almost to the exclusion of other crops. The production of hay offers the most practicable means of economically utilizing these extensive acreages of land that are in Johnson grass.[2]

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[1] Acknowledgments are due the numerous farmers, county agricultural agents, hay dealers, and hay inspectors who were interviewed in securing information for this bulletin. The author is also indebted to the Alabama Department of Agriculture, the Alabama Agricultural Experiment Station, and the Mississippi Agricultural Experiment Station for helpful suggestions and assistance in securing the field data.

[2] Farmers' Bulletin No. 1546, Systems of Livestock Farming in the Black Prairie Belt of Alabama and Mississippi, discusses the importance of hay production in connection with various types of livestock production.

The production of Johnson hay for market is already an important enterprise in this territory, and there is room for considerable expansion of the industry since the total production of marketable product is by no means sufficient to meet the requirements of readily available markets. But better and more effective methods of producing a high quality of hay are of much greater importance at the present time than is increased production, for the market for Johnson hay is in anything but a satisfactory condition, and a large percentage of the hay now produced goes begging for a market because it fails to meet the requirements of the top grades.

The production of a high quality of Johnson hay in a humid climate is often difficult on account of unfavorable weather and other conditions, and a distressingly large percentage of the Johnson hay now produced is of poor quality. Many farmers in this area have become hay producers from necessity rather than choice and are unfamiliar with methods of producing the best quality of hay. With others, the production of hay is merely a side line to other farm enterprises; odd patches of Johnson grass are cut during spare time, and little or no thought is given to producing high quality hay. The result is that a high percentage of overripe, weedy, trashy, and weather-damaged hay is produced. Efficient methods of handling the crop so as to produce a high quality of hay and reduce loss to a minimum have been worked out by many of the more successful producers. It is the purpose of this bulletin to point out the principal causes of low-grade hay and to outline the practices of some of the more successful producers.

DEVELOPMENT OF HAY PRODUCTION IN THE AREA

Commercial hay production in the Black Prairie Belt was relatively unimportant prior to 1899. Individual farms were producing hay for market, but the area as a whole was not on a hay-surplus basis. Only 2 per cent of the land in crops harvested was occupied by hay and forage crops, according to census figures. After 1899 the spread of Johnson grass compelled many farmers to give attention to hay production in order that they might realize something from land that was infested with this grass. As a result, the 10-year period ended in 1909 saw an increase of 131 per cent in the acreage devoted to hay and forage. At this time 96,243 acres, or 4.6 per cent, of the land in crops harvested was in hay and forage.

A still more rapid increase in hay production took place between 1909 and 1919, and in the latter year hay and forage crops occupied 13 per cent of the land in crops harvested. This rapid increase in hay production was due to the continued spread of Johnson grass, to an expansion of alfalfa production, and to the stimulus of high prices for hay that prevailed from 1917 to 1920. Between 1919 and 1925 the acreage in hay and forage crops decreased nearly 20 per cent. This decrease was due largely to the fact that hay prices declined rapidly, while production costs remained at a high level, a combination of conditions which caused many meadows to be neglected or to lie idle between 1921 and 1925.

Many changes have taken place in production practices since Johnson hay became an important crop in this belt. In the early days hay production was merely a side line and the haying equipment usually consisted of a 4½ or 5 foot mower, a dump rake, and a horse-power press. The crop was cut when convenient, usually after the Johnson grass had matured seed, with little regard to cutting at the time necessary for producing a good quality of hay. To-day wide-cut mowers are in common use, many large producers are using tractors instead of horses or mules for motive power in mowing, and various other types of labor-saving machinery are coming into use. (Figs. 1 and 2.) Baling is practically all done with power presses, and horse presses are seldom seen. The more progressive producers are giving thought to the development of practices that will maintain yields, increase efficiency, and produce a maximum percentage of high-quality product.

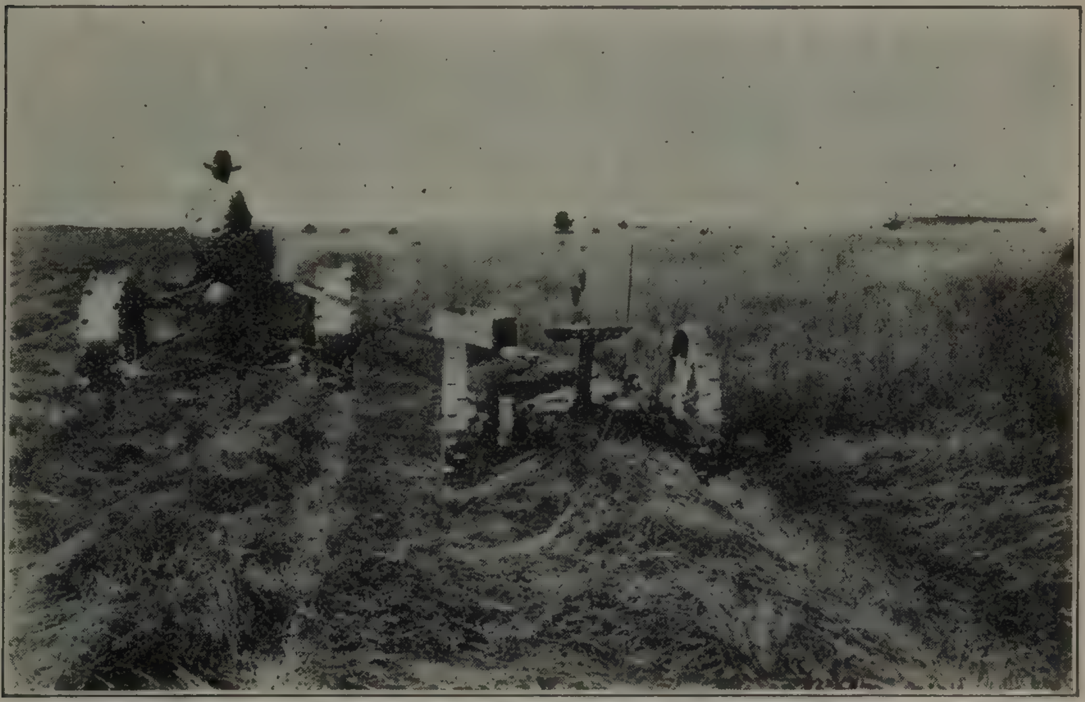

FIG. 1.—Some of the large Johnson-hay producers are using tractors in mowing. With this outfit one man can cut from 30 to 40 acres a day

CLIMATIC CONDITIONS

Length of growing season, amount and seasonable distribution of rainfall, and amount of sunshine during the haying season are factors that have much to do with both quantity and quality of Johnson hay. The average annual precipitation for the area is about 51 inches, and normally about 23 inches of this occurs during the six months when haying is carried on. The rainfall is likely to be irregularly distributed during the haying season. Local showers are often of frequent occurrence and are likely seriously to hamper haying operations. On the other hand, droughty conditions—occasionally general, but more frequently local—sometimes prevail between the months of May and November, and it is not uncommon for a relatively small district to suffer severely from drought while the surrounding country has ample rainfall, or vice versa. When these periodic droughts occur they tend greatly to reduce yields. This uncertainty of weather greatly increases the risk in Johnson-hay production in the Black Prairie Belt, and hay producers have to be constantly on the alert to guard against serious loss from weather-damaged hay.

MARKETS AND MARKETING

MARKETS FOR JOHNSON HAY

Birmingham is the principal market for Johnson hay, and Atlanta ranks next in importance. Markets of less importance are Mobile, Ala., New Orleans, La., Meridian and Hattiesburg, Miss., and Columbus, Ga. Montgomery, located in the producing section, is an important shipping market. Jacksonville was formerly a good market, but the receipt of such a large percentage of low-grade hay has practically destroyed the demand for Johnson hay in that market.

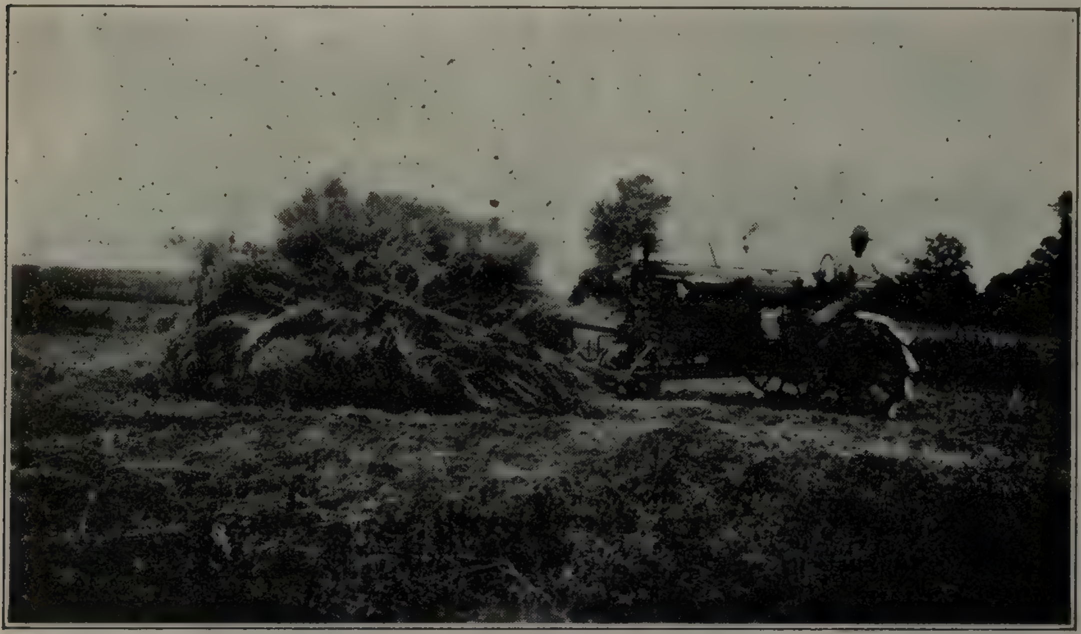

FIG. 2.—A push rake operated with a tractor saves both man and horse labor. Such an outfit can deliver from 600 to 800 pounds of hay at a load and easily keep the press working at full capacity

The demand for Johnson hay is on the decrease in most of the larger consuming and distributing markets. According to the Mobile Chamber of Commerce: "* * * the demand for Johnson hay has been decreasing for some time, this being due to the inferior grade of hay now being shipped * * *." The New Orleans Association of Commerce says: "The demand for this hay seems to be on the decrease rather than on the increase."

It is estimated that the Birmingham district annually receives about 2,400 cars of hay, of which about 35 per cent is Johnson, 30 per cent timothy, 25 per cent alfalfa, and 10 per cent made up of clover, timothy and clover mixed, Johnson and alfalfa mixed, Bermuda, and prairie hay. Atlanta takes about 1,800 cars of hay annually. Of this, about 15 per cent is Johnson, and the remainder is about equally divided between timothy and alfalfa, and includes a small quantity of clover and mixed hay. The annual consumption of hay in New Orleans amounts to about 1,000 cars, of which about

5 per cent is Johnson. Mobile uses about 400 cars, of which Johnson hay constitutes about 10 per cent.

Dealers and inspectors state that much of the timothy now received in these markets would be replaced with Johnson hay if there were any assurance that a good quality of hay could be procured. This indicates that increased quanties of high-grade Johnson hay would find a ready sale. The replacement with Johnson hay of one-half of the timothy now received in these markets would necessitate doubling the quantity of high-grade Johnson hay now being produced in the entire Black Prairie Belt.

Aside from the city markets, a considerable quantity of Johnson hay is consumed in the lumber and sawmill camps in Georgia, Florida, Alabama, and Mississippi. Part of this supply is purchased through brokers and part direct from the producer. This market is usually satisfactory when the hay shipped comes up to the grade claimed for it, and a number of producers have built up a good trade by always shipping hay according to contract. Many of these consumers will buy a lower grade of hay than that demanded by the city trade, provided the price is right. These markets offer an outlet for a considerable quantity of the low-grade hay for which there is no demand in the larger markets.

MARKET DEMANDS

In general, the trade demands a high quality of Johnson hay, and the larger markets appear to have but little call for anything lower than U. S. No. 2. Nor is the demand for the lower grades of Johnson hay likely to strengthen, for with the constantly increasing use of automobiles and trucks the consumption of hay is on the decrease, and Johnson hay is thus being forced into keener competition with hay shipped into the South from northern and western hay-surplus areas.

The wholesale hay trade generally prefers Johnson hay in small, two-wire, 14 by 16 by 40 to 44 inch bales, weighing approximately 80 pounds. Most producers endeavor to bale their hay to conform with this demand. Many of the small feed dealers retail hay in less than ton lots, and prefer a 60 to 65 pound bale. This class of dealer purchases hay by the ton and sells it by the bale.

The present unsatisfactory condition of the Johnson-hay market is due largely to prejudice against the product, brought about by the receipt of quantities of low-grade, trashy, and heat-damaged hay. In some markets this prejudice has become so strong that there is no demand for even the best quality of Johnson hay. There is no question as to the value and desirability of good Johnson hay, but dealers with an established trade, who have to depend on hay shipped from a distance, are reluctant to take a chance on an uncertain product when they can get a standard hay such as timothy that will be reasonably sure to measure up to grade. It is obvious, therefore, that the demand for Johnson hay will not be restored in such markets until the prejudice against it is removed; and this can be accomplished only by keeping low-grade hay off the market and shipping only such quality of product as will meet the requirements of the trade and measure up to the grade claimed for it.

Local shippers can aid materially in strengthening the demand for Johnson hay by carefully sorting the hay before loading it in cars, and by shipping only the class and quality called for. Shipping hay of mixed quality generally results in an unsatisfactory return, as it will usually be sold on the basis of the lowest quality rather than on the average quality of the carload. Shippers unable to fill an order with the quality of hay called for will sometimes ship a lower grade and trust to luck that the buyer will accept it, or at least make a satisfactory price adjustment. This practice has had much to do with injuring the demand for Johnson hay.

MARKETING METHODS

The marketing of Johnson hay is handled in several different ways. Many producers sell most of their product direct to the consumer. This is usually a satisfactory method where the producer is able to make the necessary contacts with consumers, as it affords the conscientious producer an opportunity to maintain satisfactory trade relations with his customers and always have a market for his product. Some producers market their hay mainly through brokers, and still others sell most of their product to local buyers. The latter practice is most common, and the bulk of the Johnson hay here produced is marketed in this manner.

No one method can be said to be best at all times. The producer needs to keep in close touch with the market in order to secure the best price for his product. The producer who has gained a reputation for square dealing, and for putting up a good quality of hay, will seldom have difficulty in marketing his product at a satisfactory price.

PRICES

The price differential between No. 1 and No. 2 Johnson hay is usually from $2 to $3 a ton. According to one producer-shipper, prices per ton for No. 1 Johnson hay f. o. b. cars at Montgomery, Ala., from 1919 to 1927 averaged about as follows:

1919–20	$20.00
1921–22	15.00
1922–23	16.00
1923–24	16.17
1924–25	$18.60
1925–26	22.00
1926–27	15.00

Prices for 1925–26 and 1926–27 are for U. S. grades; all others are for National Hay Association grades. The high price in 1925–26 was partly due to the fact that very little No. 1 was produced because of unusually bad weather.

In most markets there is usually a wide spread between the price of Johnson hay and timothy of comparable quality. For example: On August 19, 1927, Birmingham dealers were quoting No. 1 timothy (National Hay Association Grades) at $21.50 to $22, and No. 1 Johnson at $14 to $16 per ton. Dealers assume that considerable risk is attached to handling even the better grades of Johnson hay because such a large percentage is improperly cured and likely to go out of condition while in transit, or if held in storage for any length of time, whereas timothy is usually well cured and seldom depreciates in feeding value after arrival. This is given as a reason for the disparity in prices, but it is hardly conceivable that it is sufficient justification for a spread of from $6 to $7.50 per ton between comparable grades of Johnson and timothy hay. However, this price disparity serves further to emphasize the outstanding need of more careful practices in curing and baling before Johnson hay can be expected to enjoy its rightful place in the market.

GRADES[3]

Official standards for Johnson and Johnson Mixed Hay were promulgated by the United States Department of Agriculture in August, 1925. The definitions and specifications employed in these standards may be found in the Handbook of Official Hay Standards, issued by the Bureau of Agricultural Economics.

In these official standards Johnson and Johnson Mixed Hay are divided into five classes, namely, Johnson, Johnson Light Grass Mixed, Johnson Heavy Grass Mixed, Johnson Light Alfalfa Mixed, and Johnson Light Lespedeza Mixed. The class Johnson applies only to hay that is nearly pure Johnson grass, although permitting a maximum of 10 per cent other grasses, 10 per cent cane hay, and 10 per cent legumes. The class Johnson Light Grass Mixed signifies a type of Johnson hay that has a light mixture of other grasses (over 10 per cent but not over 30 per cent) and not over 10 per cent legumes. The other classes are based on similar percentage allowances.

The various classes are divided into three numerical grades and a Sample grade. The grading factors in the numerical grades are color and foreign material. Color is the more important factor because it is an indication of quality in hay. Thus the grade varies in these standards according to the quantity of natural green color preserved in the hay.

Foreign material affects the grade according to the quantity contained in the hay, and thus the grade may be lowered on account of foreign material, even though the hay is green and well cured. Sample grade is used to describe hay which contains excessive quantities of foreign material, which is unsound because of a heating, is hot, wet, musty, or in caked condition, or which is severely stained, overripe, or weathered.

Special grades for extra green hay, fine hay, and coarse hay are used to supplement the numerical grades when the hay has these special qualities. The special grade Fine indicates a type of early cut and leafy Johnson hay that has relatively high-feed value as compared with Johnson hay with coarse stalks. The special grade Coarse indicates Johnson hay that is mature as well as hay that has stalks of large diameter.

CAUSES OF LOW-GRADE HAY

Numerous circumstances are responsible for the large quantity of low-grade hay normally produced in the Black Prairie Belt. Among these are unfavorable weather; the presence of weeds or such trash as cornstalks and cotton stalks; delay in cutting until the grass stems are woody and unpalatable, the bottom leaves dead and brown, and the seed heads mature; inadequate equipment for handling the crop expeditiously; careless curing methods; putting up hay in poorly constructed cocks or stacks; baling before the hay is properly cured; heat damage caused by storing freshly baled hay in barns or warehouses without proper ventilation between the bales; storing in sheds or barns that have leaky roofs; and shipping too soon after baling, with the result that the hay heats and goes out of condition while in transit.

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[3] Supplied by E. C. Parker, assistant chief marketing specialist, in charge of hay standardization.

All things considered, the weather factor is probably the most serious problem confronting the producer of Johnson hay when it comes to putting up a high percentage of good-grade product. Not only is a large quantity of hay damaged each year by being rained on while in the swath or windrow, but a prolonged rainy spell will frequently delay cutting until the grass is past the stage for making a good quality of hay. A certain amount of damage from rains is unavoidable, for with a haying season extending over a period of five to six months in a humid climate it is obvious that even the most efficient producers will at times meet with difficulty in curing their hay in a satisfactory manner. Intermittent showers are likely to occur after the grass is cut, and when this happens bleached or otherwise-damaged hay is almost sure to result.

A small percentage of weeds is unavoidable in Johnson hay, but a high percentage of weedy hay is usually an indication of poor meadow management, or of a cool, backward spring which has retarded the growth of Johnson grass and given various hardy weeds a chance to get a good start in the meadows. In the latter case the first cutting will be weedy, but if the stand of Johnson grass is good there will be little trouble from weeds in the second and later cuttings. Farmers' Bulletin 1476, Johnson Grass: Its Production for Hay and Pasture, discusses weed control in Johnson-grass meadows.

The presence of any considerable quantity of cornstalks, cotton stalks, or other foreign material lowers the grade of Johnson hay, even though the hay itself is of good quality. Trashy hay of this sort usually results where cultivated land is first converted into meadow, or where a crop of corn or cotton has been grown on land that was broken up for the purpose of thickening the stand of Johnson grass, or where scattered bunches of damaged hay from the previous cutting have been left on the meadow. Meadows should always be cleaned of all trash before the Johnson grass starts in the spring, and should be raked clean after each cutting so that no bunches of old hay are left to be raked up with the succeeding crops.

Failure to cut Johnson grass at the proper stage of maturity is one of the most common causes of low-grade hay. This delay in cutting is sometimes unavoidable on account of inclement weather, but probably just as frequently is due to ignorance of the proper time to cut, or to a lack of time caused by the demands of crops that compete with the hay crop in the employment of labor. Whenever mowing is delayed until the stems are woody and unpalatable many of the bottom leaves will have become dead and brown, and the result will be a product that is low in feeding value as well as badly off in color.

The best time to cut is when the heads are just emerging from the "boot," but where a large acreage is handled it is impossible to cut all of the first crop when the grass is in the proper stage. However, Johnson grass, and especially the first cutting, is likely to be uneven in development, and one meadow or a portion of a meadow may be ready to cut several days ahead of the rest. When this occurs cutting should begin on the more advanced portion as soon as it is ready. Later crops may be cut at approximately the right time by cutting the meadows in the same order as that followed in cutting the first crop.

Inadequate equipment is responsible for the failure of some producers to put up a larger proportion of marketable hay. Frequently a producer with 200 to 300 acres of Johnson grass will have only such equipment as will enable him to handle one-half of his acreage in a satisfactory way. The result is that he is usually behind, and either a large proportion of his crop is left too long before cutting, or he cuts a larger acreage than he can possibly save in good condition.

Careless and slipshod methods of handling hay while it is curing are responsible for a considerable quantity of low-grade hay. Leaving hay exposed to heavy dew and bright sunshine for several days while in the swath or windrow will cause bleaching and will materially lower the grade. On partly cured hay, two heavy dews alternating with hot sunshine will do more damage than a heavy shower. Hay in large windrows is likely to weather stain in damp, cloudy weather unless the windrows are turned over and aired. The more successful producers strive to get their hay in the bale, the cock, or the stack with the least possible exposure to the weather.

Putting up hay in loose, poorly topped cocks, or in stacks that are not constructed to shed rain, or stacking on low moist land where hay in the bottom of the stack will absorb ground moisture, result in much damaged hay. Hay put up in large, well-built cocks will stand considerable rain with but little damage, but careful supervision of labor is necessary to have such work properly done. The same holds true for stacking hay, but, unfortunately, laborers who have the ability to build a good stack are not plentiful in this area.

Baling hay before it is properly cured usually results in a heat-damaged product. Likewise, storing freshly baled hay in poorly ventilated barns or warehouses, or without leaving air spaces between the bales is more than likely to result in considerable damage from heating.

Hay baled from the windrow or cock should remain in storage from 20 to 30 days before it is shipped. The bales should be piled on edge and each tier cross-piled on the tier below. Hay shipped immediately after baling from the windrow is almost certain to heat in transit and result in a moldy, heat-caked product when it arrives at destination. This results in lowering the quality of the hay and is one of the most common sources of trouble between shippers and receivers of Johnson hay. Considerable quantities of good Johnson hay are ruined each year by being stored in old cabins, sheds, or barns with leaky roofs.

Buildings used for storing baled hay may be inexpensive, but it is essential that they be well ventilated and well roofed.

ESSENTIALS OF PROFITABLE HAY PRODUCTION

Maximum returns from Johnson-hay production can be realized only by adopting methods of management that result in keeping the meadows relatively free from weeds and in a high state of productivity, and by giving close attention to hay-making practices that result in efficiency and the production of a high quality of product. Good meadow management is essential in order that both quality and quantity of hay may be produced. Fortunately, the practices that are necessary for producing maximum yields also cover some of the principal requirements for the production of the best quality of hay.

FIG. 3.—On some of the more fertile soils Johnson grass will produce from three to four cuttings a year, yielding from 2 to 3 tons to the acre for the season. This field produced four cuttings a year, with an aggregate yield of 4 tons to the acre

A well-managed Johnson grass meadow should produce from three to four cuttings a year, yielding a total of 2 to 3 tons per acre, and even better yields are frequently secured on some of the more fertile areas. (Fig. 3.) But on many of the older meadows the annual removal of a considerable tonnage of hay has resulted in greatly reduced yields, in some instances to an extent where production is no longer profitable.

Many producers claim that with the prevailing low prices for Johnson hay it is impossible to secure a profitable return when the yield falls below half a ton to the acre for each of the two or more cuttings made during the season. This may not be true in all instances, but very efficient management is necessary to bring a satisfactory return from such low yields. Satisfactory yields can be secured only by maintaining a good stand of grass, and by proper attention to keeping up the fertility of the soil. Methods of meadow management for maintaining good stands of Johnson grass and practices resulting in maximum production are discussed in detail in Farmers' Bulletin 1476, Johnson Grass: Its Production for Hay and Pasturage.

METHODS OF PREPARING JOHNSON HAY FOR MARKET

Producers differ widely in their methods of preparing Johnson hay for market. It can hardly be said that there is any usual practice of haymaking for the area as a whole, but every producer of consequence follows a more or less definite system under normal conditions. Some practice curing in the swath and windrow, and bale directly from the windrow; others put the hay up in cocks before it is thoroughly cured and bale after it has stood in the cock for several days; still others follow the practice of stacking their hay and letting it go through the sweating or fermenting process before baling.

Practically all producers find it necessary or desirable to vary their practices from time to time to conform to weather conditions, available equipment, supply of labor, and acreage to be harvested. Those who make a practice of baling from the windrow sometimes find it necessary to cock or stack part of their hay in unfavorable weather or when there is a shortage of labor, and those who usually stack their hay will often bale a part of their product from the windrow or cock when weather conditions are unusually favorable and when there is an ample supply of labor. Methods employed under large-scale production are likely to differ from those where production is on a small scale.

Under normal conditions the windrow-baling and the stacking methods are most common. Each has certain things in its favor, the question as to which is the better method depending largely on the efficiency of the farm organization, on weather conditions at haying time, on the supply of labor, and on the amount of room available for storing the baled hay.

Baling from the windrow is more generally practiced by extensive hay producers whose farms are organized and equipped to handle the crop efficiently. Under favorable conditions this is undoubtedly the most economical method of handling Johnson hay.

Two methods of stacking are in vogue—putting the hay in 12 to 15 ton stacks with the use of a stacker (figs. 4 and 5), and stacking by hand in small stacks of from 1 to 3 tons each (figs. 6 and 7). The latter is the more common method. The use of stackers would probably be more general if more men were skilled in building large stacks so as to shed rain, or if producers were not reluctant to invest in equipment with which they are not familiar.

Various methods of mowing, curing, stacking, and baling Johnson hay are discussed in Farmers' Bulletin 1476, Johnson Grass: Its Production for Hay and Pasture.

EXAMPLES OF HAY-MAKING PRACTICES

Examples of practices followed by different producers are here given to illustrate the windrow-baling method, the large-stack method, and the small-stack method of handling Johnson hay. These are presented as typical examples of methods followed by some of the producers who are successful in putting up a maximum quantity of high-quality hay. In general, they represent the most efficient practices in handling Johnson hay under the various conditions that exist on different types of farms in this area.

FARM NO. 1

Farm No. 1 is a highly specialized farm on which hay is the only crop produced. Approximately 1,500 acres of Johnson grass are cut annually. About 1,000 acres are cut twice, and the remainder is cut three times, making the season's total mowing about 3,500 acres. A large portion of the land on this farm is thin and relatively unproductive, so yields range from about one-fourth to 1 ton to the acre per cutting. In spite of this low yield, the operator of this farm is one of the most successful hay producers in the section in the efficient use of labor and in saving a maximum amount of high-quality hay. His success is due largely to the use of power machinery, efficient management, and personal supervision of all of the work.

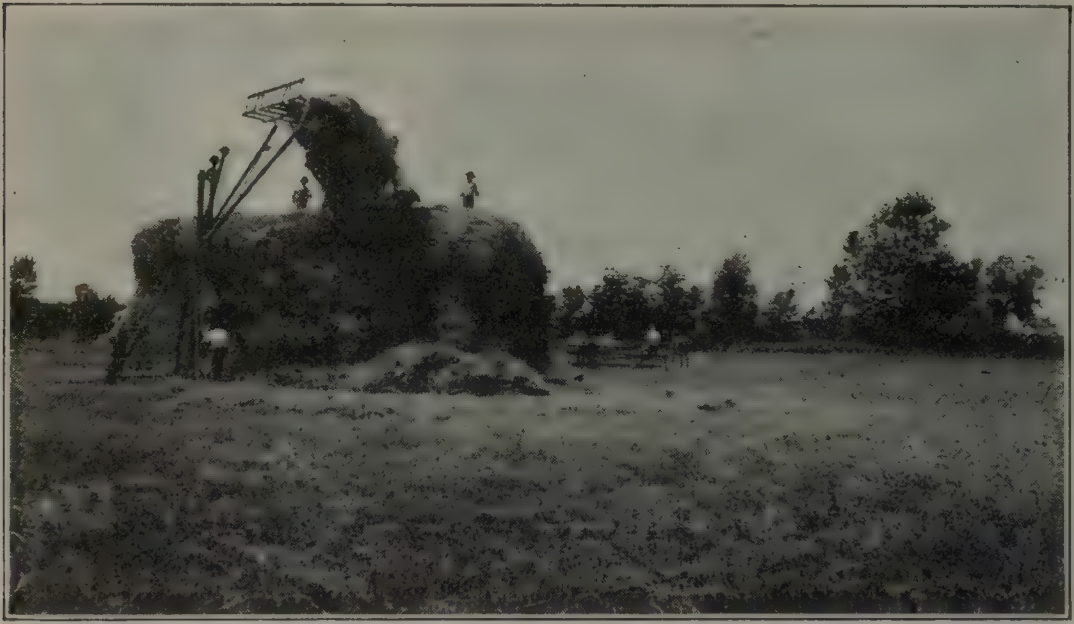

FIG. 4.—By building large stacks with a stacker and push rakes, hay can be handled much more efficiently than when put by hand into small stacks, such as those shown in Figures 6 and 7

All work except that with the self-dump rakes is performed with power-operated machinery. The mowing is done with two 6-foot mowers drawn by a tractor. One man with this outfit does all the mowing, the average day's cut ranging from 35 to 40 acres. Mowing starts as soon as the grass begins to head and, on account of the extensive acreage operated, continues with but little interruption (except for bad weather) until the end of the season.

Under normal conditions the usual method of curing and baling is to let the hay lie in the swath for about 24 hours after mowing, then rake into windrows, and bale the following day. In exceptionally favorable weather, and when the ground is dry, hay cut in the morning is frequently raked into windrows in the afternoon of the same day and baled the day following, and on some occasions hay has been cut and baled the same day without loss. In uncertain weather, when baling from the windrow would be unsafe, the hay is sometimes put up in large cocks and left until the weather becomes settled before being baled.

The baling begins as soon as about 20 tons—or enough hay for one day's baling—is cured enough to bale with safety. The hay is delivered to the press with a push rake operated with a tractor. (Fig. 2.) With this outfit from 600 to 800 pounds of hay is pushed to the press at one time, and the press is kept working at full capacity. Each load is pushed close to the press so that no time will be lost by the pitchers in getting the hay to the feeder.

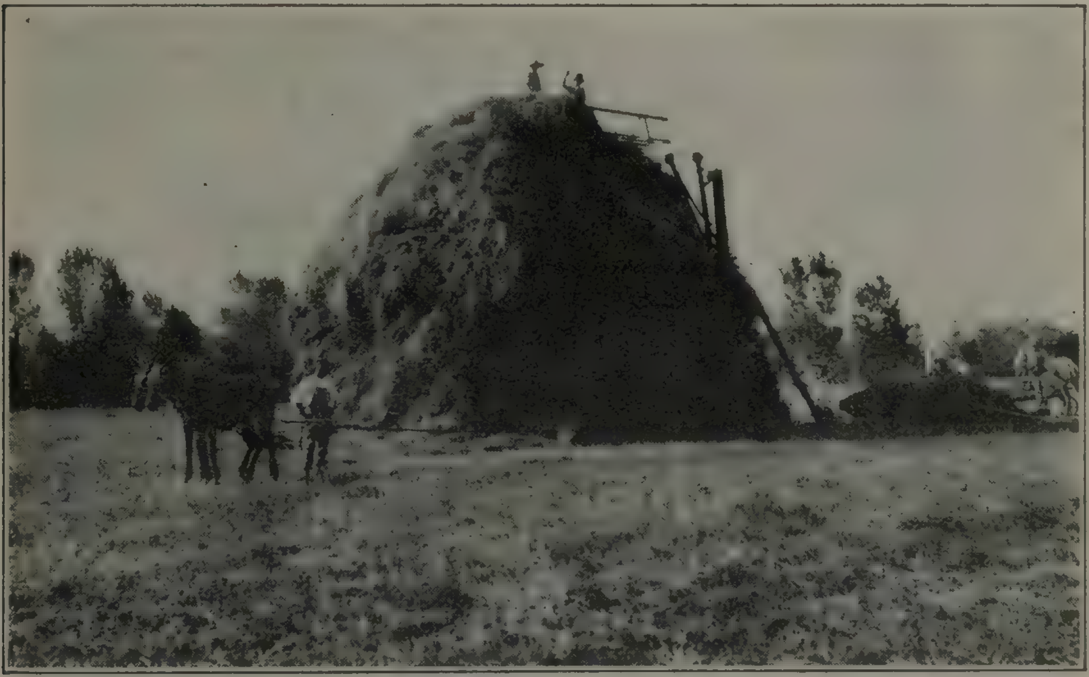

FIG. 5.—Topping out the stack with freshly cut grass. Stacks shed rain better and are less liable to have the tops blown off if they are topped out with freshly cut grass or partly cured hay

The baled hay is stored in barns and warehouses, the bales being piled on edge and cross piled, with an air space between them for ventilation. Windrow-baled hay is kept in storage from 20 to 30 days before it is shipped. Handled in this manner, hay will seldom heat in the bale and will not go out of condition while in transit.

The equipment on this farm consists of the following:

Four mules—for use on the dump rakes.
One tractor—used for mowing.
One tractor—used on push rake.
One tractor—used on hay press.
Two 6-foot mowers.
Two 12-foot self-dump rakes.
One push rake.
One hay press.
Two trucks.

The regular haying crew on this farm consists of one man and tractor at the mowing, two men and two teams at the raking, one man and tractor at the push raking, and six men at the baling. Once the haying is under way this crew of 10 men will, under normal conditions, put up an average of 18 tons a day. Expressed in hours of man labor the time required to harvest and bale a ton of hay with yields ranging from one-half to 1 ton to the acre for each cutting is about as follows:

	½-ton yield	¾-ton yield	1-ton yield
	Hours	*Hours*	*Hours*
Mowing (with tractor)	0.57	0.38	0.29
Raking (two-horse rake)	.83	.55	.42
Turning windrows with rake	.20	.20	.20
Push raking (with tractor)	.55	.55	.55
Raking after push rake	.08	.08	.08
Baling	3.33	3.33	3.33
Total per ton	5.56	5.09	4.87

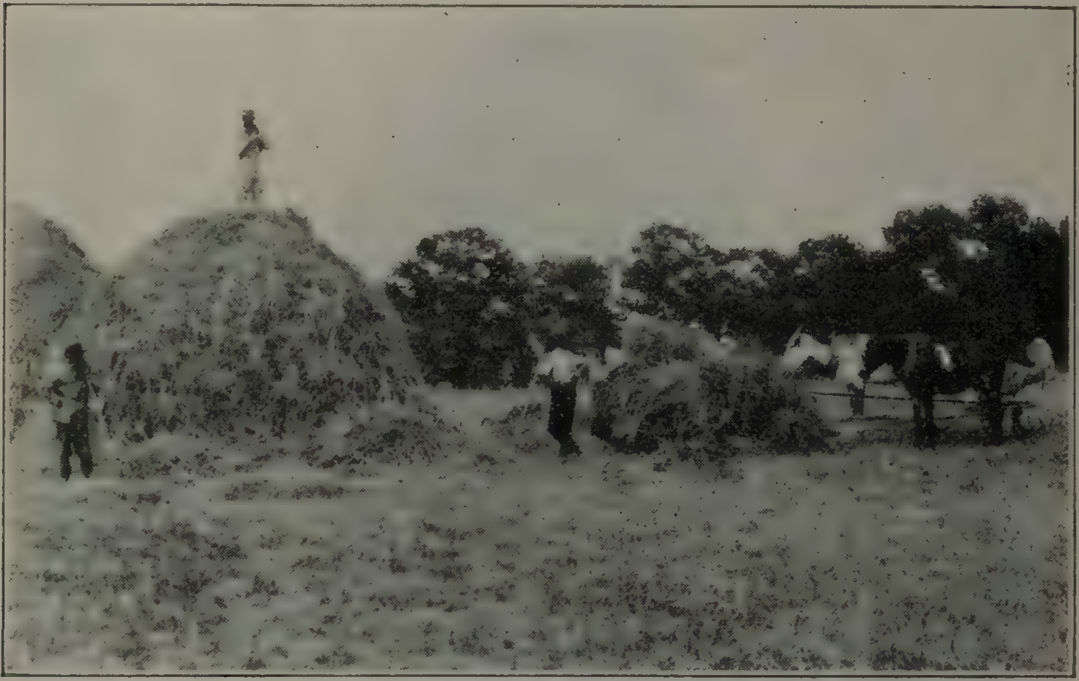

FIG. 6.—The usual crew used in stacking by hand consists of one man on the push rake to bring the hay to the stack, one man to build the stack, and two men to pitch the hay to the man on the stack. Where stacking by hand is practiced it is not practicable to build large stacks, nor does this method permit of the most efficient use of labor

The practices followed on this farm are well suited to large-scale production, and especially where the production of hay is the principal farm enterprise. The use of power machinery results in a considerable saving of both man and horse labor in mowing and push raking, and baling from the windrow eliminates the time and labor of stacking. It must be kept in mind, however, that success in baling from the windrow is largely dependent on close attention to details on the part of the operator, and on his knowledge of when the hay is cured sufficiently to be baled with safety.

FARM NO. 2

Farm No. 2 is a hay and livestock farm on which 100 acres of Johnson grass are handled with horsepower machinery and most of the crop is baled from the windrow. This farm offers a good example of efficient hay making on a smaller scale than on farm No. 1, and with a minimum amount of equipment. The meadows on this farm are rich lowland yielding four cuttings a year, with an average annual production of 4 tons to the acre. As the meadows are kept smooth and clean, an 8-foot mower can be used.

Haying begins when the grass is in the "boot," and the 100 acres are usually cut over in about two weeks. The mowing is done with an 8-foot mower drawn by three horses. Under normal conditions the mowing is done between 4 p. m. and 10 o'clock the following morning, and all hay is raked into windrows in the afternoon. In this way all the hay is put into windrows before any dew falls on cured hay while it is in the swath. Should the weather become showery after the hay is cut and before it has been raked it will be left in the swath, for hay will suffer less damage from getting wet in the swath than from getting wet in the windrow.

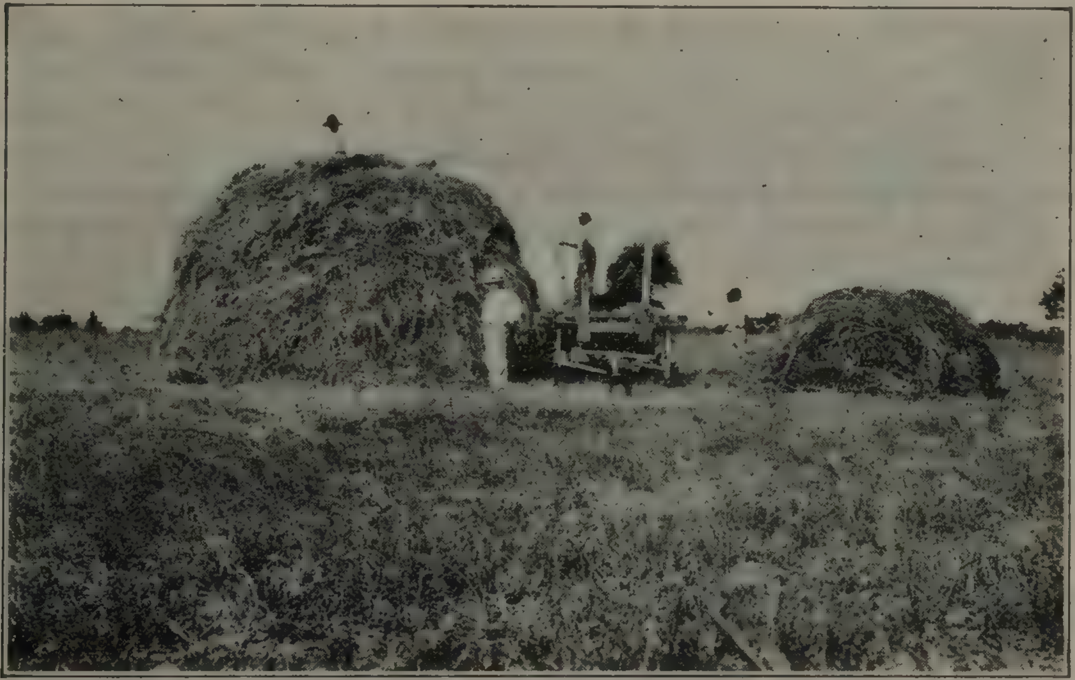

FIG. 7.—Another method of hand stacking is to place a wagon with a hayrack at the side of the stack when the latter has been built as high as a man can pitch from the ground. One man then pitches the hay to the wagon, and the second man pitches it from the wagon to the stack. This method permits the building of a larger stack, but is even more wasteful of labor than the method shown in Figure 6

Hay is usually baled the day after it is put in the windrow, but if not sufficiently cured for baling with safety, it will be left in the windrow for another day. Where the windrows are heavy they are turned over with the dump rake an hour or so before baling. Baling is done with a horsepower press, the hay being brought to the press with a push rake. Six men and four horses will bale an average of 12½ tons from the windrow in 10 hours.

Baled hay is stored for two weeks or more before it is shipped. When put in storage, the bales are always piled on edge, with an air space between them to permit ventilation and guard against any heating in the bale.

The equipment on this farm consists of the following:

Eight horses.
One 8-foot three-horse mower.
One 12-foot self-dump rake.
One push rake.
One two-horse press.

Eight men can cut, cure, and bale an average of 12½ tons in a 10-hour day. The number of man hours required to harvest and bale a ton of hay for yields of one-half, three-fourths, and 1 ton to the acre for each cutting are approximately as follows:

	½-ton yield	¾-ton yield	1-ton yield
	Hours	*Hours*	*Hours*
Mowing (3 horses on 8-foot mower)	1.33	0.88	0.67
Raking (12-foot 2-horse rake)	1.00	.67	.50
Turning windrows with rake	.20	.20	.20
Push raking to press	.80	.80	.80
Raking after push rake	.08	.08	.08
Baling with horse press	4.00	4.00	4.00
Total per ton	7.41	6.63	6.25

The practices followed on this farm are applicable to farms where 100 acres or less of Johnson grass are handled. The investment in machinery is relatively small, and the handling of labor and equipment generally efficient.

FARM NO. 3

Farm No. 3 is a hay and livestock farm on which about 900 acres of Johnson grass are cut annually, and most of the hay is put up in large stacks. In addition to hay, about 80 acres of oats, 115 acres of corn, and 15 to 20 acres of miscellaneous crops are grown. Yields average about 2 tons to the acre per year.

The stand of Johnson grass is maintained by disking parts of the meadows each spring and breaking up and planting part of the land to oats or a cultivated crop every few years. Where the land is thin, it is sown to sweet clover to build up the soil and increase productivity.

The usual haying practice on this farm is to start mowing as soon as the grass begins to head and keep the mowers going until the entire acreage has been cut over. The mowing is done with two mowers—one 6-foot and one 7-foot—drawn by a tractor. An average of about 35 acres per day is cut with this outfit. As soon as the hay in the swath is well wilted it is raked into small windrows. The following day the heavier windrows are turned over with a side-delivery rake, and if the hay is well cured it is immediately stacked. If the weather is unfavorable for rapid curing and the hay not well enough cured for stacking, it will be left a day longer in the windrow. Occasionally, when conditions are favorable, part of the hay is baled from the windrow.

Stacking is done with a stacker and push rakes, and the stacks contain from 12 to 15 tons each. A crew of five men with two push rakes and a stacker put up an average of 25 tons a day. As far as practicable the stacks are built on dry, well-drained ground where the slope is away from the stack so as to minimize the danger of having hay in the bottom of the stack damaged by absorbing moisture from the ground or by water from a heavy rainfall running under the stack.

The hay is left in the stacks until it has gone through a sweat before it is baled. Before baling all hay on the outside of the stack that has been damaged by exposure to the weather is raked off so that no weather-damaged or stained hay will get into the bales. When the market is satisfactory, hay is shipped as soon as baled; otherwise it is stored in barns and sheds. Storage room for 380 tons of baled hay is available on this farm.

The haying equipment of this farm consists of the following:

Ten horses and mules.
Two mowers (one 6-foot and one 7-foot).
One tractor used for mowing.
Two self-dump rakes.
Two push rakes.
One side-delivery rake.
One stacker.
One power press.
One 15–30 tractor used to operate press.

The crew used in cutting, curing, and stacking consists of 1 man and tractor at the mowing, 2 men and 2 teams at the raking, 2 men and 2 teams at the push raking, 1 man and team operating the stacker, and 2 men building the stack, a total of 8 men and 10 mules. With hay yielding three-fourths ton to the acre this crew will put up about 25 tons a day. The baling crew of 6 men will bale an average of about 16 tons a day from large stacks. The amount of time required per ton for cutting and raking varies with the yield per acre, whereas that for stacking and baling remains relatively constant. Under normal conditions the hours of man labor per ton in handling hay by this method will be about as follows for yields of one-half, three-fourths, and 1 ton to the acre for each cutting:

	½-ton yield	¾-ton yield	1-ton yield
	Hours	*Hours*	*Hours*
Mowing (with tractor)	0. 57	0. 38	0. 29
Raking (2-horse rake)	. 83	. 55	. 42
Turning windrows (2-horse rake)	. 20	. 20	. 20
Push raking (2 horses)	. 80	. 80	. 80
Raking after push rake (2-horse rake)	. 08	. 08	. 08
Stacking (2 horses on stacker)	1. 20	1. 20	1. 20
Baling	3. 75	3. 75	3. 75
Total per ton	7. 43	6. 96	6. 74

If the same equipment is used in cutting and raking, hay can be put up in large stacks with about 40 per cent less man labor than it requires to cut, rake, and bale from the windrow. Therefore this method of putting up hay in large stacks is suitable for handling a large acreage where labor is scarce at haying time, or where other farm enterprises interfere with haying demands for labor.

FARM NO. 4

Farm No. 4 is a cotton, corn, hay, and livestock farm. About 300 acres of Johnson grass are cut for hay each year, the average annual yield being 2 tons to the acre. Practically all the hay is put up in small stacks. Croppers and renters living on the plantation supply most of the labor used in haying. This arrangement works to the advantage of both labor and operator; the former are given occupation when they might otherwise be idle, and the latter is assured of an ample supply of labor when needed in haying.

The usual haying practice on this farm is to start mowing as soon as the Johnson grass begins to head. Mowing is done with two mowers drawn by mules, each mower cutting an average of 12 acres in a 10-hour day. In favorable weather hay that is cut in the forenoon is raked into windrows in the afternoon, and that cut in the afternoon is windrowed the following day. Hay is usually stacked the day after it is put in windrows, but if the weather is not favorable for rapid curing the hay is left in the swath until the second day before being raked and is not stacked until the third day. If the hay is heavy and rank or there is considerable moisture in the ground, the windrows are turned over with a self-dump rake an hour or so before stacking so that hay in the bottom of the windrow will dry out before being put in the stack.

Hay is brought to the stacks with push rakes and stacked by hand. The stacks are in groups of three—all three being built at the same time—and contain from 1½ to 2 tons each. The stacking crew consists of 11 men, 2 operating push rakes, and 3 at each of the stacks. This crew stacks around 36 tons a day. The hay is baled from 10 to 20 days after stacking, according to weather conditions and the labor demands of other farm work.

The equipment used in haying on this farm is:

Twelve mules.
Two mowers.
Two self-dump rakes.
Two push rakes.
One hay press.
One tractor for operating the press.

Only 8 mules are used continuously in haying; the other 4 are extras supplied from the regular farm work stock.

When haying operations are in full swing a crew of 15 men is usually employed in cutting, curing, and stacking: Two men and 2 teams, mowing, 1 man and team raking the hay into windrows, 1 man and team turning windrows and raking after the sweep rakes, 2 men on push rakes delivering hay to the stacks, and 9 men stacking. As this stacking crew can handle as much hay in one day as the mowing crew will cut in from one and one-half to three days—depending on the yield per acre—they may be employed at baling hay or other farm work about half the time. The baling crew consists of 6 men. This crew bales an average of 15 tons a day. To move and set up the press three or four times a day cuts down the efficiency of the baling crew.

On the basis of a normal 10-hour duty for the different crews the hours of man labor required to harvest, stack, and bale a ton of hay for yields of one-half, three-fourths, and 1 ton to the acre for each cutting are about as follows:

	½-ton yield	¾-ton yield	1-ton yield
	Hours	*Hours*	*Hours*
Mowing (with mules)	1. 67	1. 11	0. 83
Raking (two-horse rake)	. 83	. 55	. 42
Turning windrows (two-horse rake)	. 20	. 20	. 20
Push raking (two horses)	. 55	. 55	. 55
Raking after push rake (two-horse rake)	. 08	. 08	. 08
Stacking by hand	2. 50	2. 50	2. 50
Baling	4. 00	4. 00	4. 00
Total per ton	9. 83	8. 99	8. 58

The practice followed on this farm is the least efficient of any of the methods discussed, but it is all too common with many producers who are handling 100 or more acres of Johnson grass. This practice is suitable for farms on which the acreage in hay is too small to justify any considerable investment in haying equipment and on which labor is cheap and plentiful, but with a business of this size the use of power machinery in mowing would reduce the man labor for this operation by two-thirds, and the use of a stacker would cut down the man labor in stacking one-third.

SUMMARY

There is need for strengthening the demand for Johnson hay. This can be accomplished by keeping low-grade hay off the principal consuming and distributing markets, and by shipping only such quality of product as will meet the market demands. Therefore it is essential that producers adopt production practices that will result in the output of a greater percentage of good-quality hay, and seek other outlets for the lower grades.

A larger percentage of high-quality hay can be produced by adopting such practices of meadow management as will reduce the percentage of weeds and other foreign material in the hay; by cutting at a time to avoid an overripe, woody, and unpalatable product; by more careful methods of curing, cocking, and stacking to minimize the damage from bleaching and weather-staining; and by greater care in baling and storing the baled hay to avoid heating and going out of condition in the bale.

Under normal conditions the best quality of Johnson hay is cut before it has formed heads, is properly cured, and is gotten under shelter with the least possible exposure to weather. The method which will be most effective in accomplishing this depends largely on weather conditions, season of the year, supply of labor, storage room for the baled hay, and judgment of the individual producer.

Success in handling hay in stacks is dependent on ability to build stacks that will shed rain. Poorly constructed stacks are responsible for serious losses of quality in hay. Hay that has been allowed to go through a sweat in the stack may be loaded on cars as soon as baled with little danger of its going out of condition in transit.

Baling from the windrow results in a considerable saving in labor but is attended with greater risk than when hay is properly stacked and allowed to go through a sweat before baling. This method requires close supervision on the part of the operator, and unerring judgment as to when the hay is in proper condition to be baled with safety. Hay baled from the windrow should not be shipped for 20 to 30 days after baling, hence considerable room for storing the baled hay is essential where this method is practiced.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

November 1, 1928

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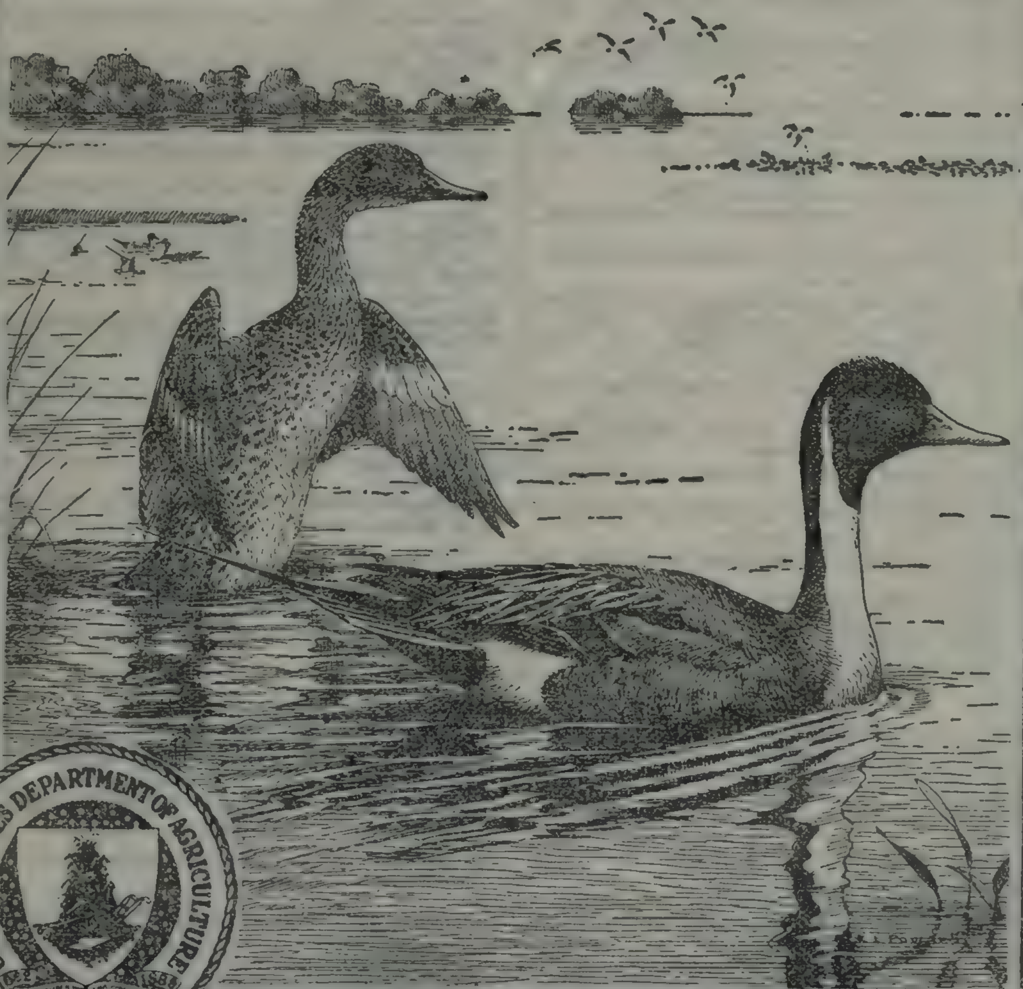
U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1575

GAME LAWS

FOR THE SEASON
1928-29

A Summary of the Provisions of Federal, State, and Provincial Statutes



THE twenty-ninth annual summary by the Department of Agriculture of Federal and other game laws and regulations is here presented for the use of law-enforcement officials, sportsmen, conservationists, and others as an aid in the administration of the migratory-bird treaty and Lacey Acts. The provisions as set forth furnish a brief and convenient synopsis of the laws. Provisions relating to methods of capture, game refuges, enforcement of laws, disposition of fees and fines, and minor matters are omitted, as also are texts of Federal and Canadian laws and regulations relating to birds and game. The illustration on the title-page of this bulletin is of pintail ducks (*Dafila acuta tzitzihoa*) from a drawing by E. L. Poole

Washington, D. C. Issued September, 1928.

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[Violations of Federal Game Laws may be reported to the Chief, Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C., or to the nearest United States game or reservation protector, a list of whom appears on page 46.]

Federal laws: Secretary of Agriculture, Washington, D. C.
Alabama: Department of Game and Fisheries, Montgomery.
Alaska: Executive Officer, Alaska Game Commission, Juneau; or Secretary of Agriculture, Washington, D. C.
Arizona: State Game Warden, Phoenix.
Arkansas: Secretary Game and Fish Commission, Little Rock.
California: Executive Officer, Fish and Game Commission, Postal Telegraph Building, San Francisco.
Colorado: State Game and Fish Commissioner, Denver.
Connecticut: Superintendent of Fisheries and Game, Hartford.
Delaware: Chief Game and Fish Warden, Dover.
District of Columbia: Superintendent Metropolitan Police, Washington.
Florida: State Game Commissioner, Tallahassee.
Georgia: Game and Fish Commissioner, Atlanta.
Hawaii: Fish and Game Division, Board of Agriculture and Forestry, Honolulu.
Idaho: Fish and Game Warden, Boise.
Illinois: Director Department of Conservation, Springfield.
Indiana: Superintendent of Fisheries and Game, State House, Indianapolis.
Iowa: State Fish and Game Warden, Des Moines.
Kansas: State Fish and Game Warden, Pratt.
Kentucky: Executive Agent Game and Fish Commission, Frankfort.
Louisiana: Commissioner of Conservation, Court Building, New Orleans.
Maine: Commissioner of Inland Fisheries and Game, State House, Augusta.
Maryland: State Game Warden, 514 Munsey Building, Baltimore.
Massachusetts: Director Division of Fisheries and Game, State House, Boston.
Michigan: Director Department of Conservation, Lansing.
Minnesota: Game and Fish Commissioner, Department of Conservation, St. Paul.
Mississippi: Secretary of State, Jackson; or Sheriff or County Clerk.
Missouri: Game and Fish Commissioner, Jefferson City.
Montana: State Fish and Game Warden, Helena.
Nebraska: State Game Warden, Lincoln.
Nevada: Secretary State Fish and Game Commission, Reno.
New Hampshire: Fish and Game Commissioner, Concord.
New Jersey: Secretary Board of Fish and Game Commissioners, Trenton.
New Mexico: State Game Warden, Santa Fe.
New York: Secretary Conservation Commission, Albany.
North Carolina: Director Department of Conservation and Development, Raleigh.
North Dakota: Game and Fish Commissioner, Bisbee.
Ohio: Chief Division of Fish and Game, Department of Agriculture, Columbus.
Oklahoma: State Fish and Game Warden, Oklahoma City.
Oregon: State Game Warden, Portland.
Pennsylvania: Executive Secretary, Board of Game Commissioners, Harrisburg.
Rhode Island: Chairman Commissioners of Birds, Providence.
South Carolina: Chief Game Warden, Columbia.
South Dakota: Director Game and Fish Commission, Pierre.
Tennessee: State Game and Fish Warden, Nashville.
Texas: Game, Fish, and Oyster Commissioner, Austin.
Utah: Fish and Game Commissioner, Salt Lake City.
Vermont: Fish and Game Commissioner, Montpelier.
Virginia: Executive Secretary, Commission of Game and Inland Fisheries, Richmond.
Washington: Supervisor of Game and Game Fish, 404 Bell Street Terminal (P. O. Box 384), Seattle.
West Virginia: Game and Fish Commission, Charleston.
Wisconsin: Conservation Director, Madison.
Wyoming: State Game and Fish Commission, Cheyenne.

Canada: Commissioner, National Parks of Canada, Ottawa.
Alberta: Game Commissioner, Edmonton.
British Columbia: Provincial Game Warden, Victoria.
Manitoba: Chief Game Commissioner, Winnipeg.
New Brunswick: Chief Game Warden, Fredericton.
Northwest Territories: Director, Northwest Territories and Yukon Branch, Department of Interior, Ottawa, Ontario.
Nova Scotia: Minister of Lands and Forests, Halifax.
Ontario: Department of Game and Fisheries, Toronto.
Prince Edward Island: Game Inspector, Provincial Treasury Department, Charlottetown.
Quebec: General Superintendent of Fisheries and Game, Quebec.
Saskatchewan: Game Commissioner, Regina.
Yukon: Gold Commissioner, Dawson.

Newfoundland: Secretary, Game and Inland Fisheries Board, St. Johns.

Mexico: Secretaria de Agricultura y Fomento, City of Mexico.

This bulletin is a contribution from
Bureau of Biological Survey .... PAUL G. REDINGTON, *Chief.*
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GAME LAWS FOR THE SEASON 1928–29

A SUMMARY OF FEDERAL, STATE, AND PROVINCIAL STATUTES

By **Frank L. Earnshaw**, *Administrative Assistant, Division of Game and Bird Conservation, Bureau of Biological Survey*

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FEDERAL PROTECTION OF GAME

IN THE UNITED STATES AND CANADA certain game laws are enacted by States and Provinces, and some, national in character, are written on the statute books of the Nation and the Dominion. Among the most far-reaching of these are laws that were passed in 1918 authorizing regulations thereunder to give force to a treaty between the United States and Great Britain for the protection of North American migratory birds. In the United States and Canada these are known, respectively, as the migratory-bird treaty act and the migratory-birds convention act.

Game administration involves more than the mere exercise of police power for the protection of wild life. Too frequently game laws are considered to have protection as their sole end, and consequently in some States they are so inelastic as to prevent modification to meet changing conditions. Fortunately, however, a number of States recognize the need for more elastic laws and have empowered game officials to develop and execute conservation programs that may be modified as changing conditions warrant.

It is one of the functions of the United States Department of Agriculture to conserve game and to protect migratory birds. Its jurisdiction was extended to game in 1900 by the passage of the Lacey Act, which supplements State legislation by regulating interstate commerce in wild animals or parts thereof and governs the importation of foreign wild mammals and birds. This act has proved of material assistance in the suppression of illegal interstate traffic in game and the skins of fur animals, and since its passage no injurious foreign species of wild bird or mammal, so far as known, has gained a foothold in this country.

In 1913 the first Federal migratory bird law was passed and its enforcement placed in this department, as also was the administration of the subsequent treaty legislation. The act of 1918 is a measure that has had a most beneficial effect on coordinating State laws relating to migratory game birds and is generally observed and in most places respected. This legislation conferred upon the department power to regulate the taking, possession, and disposition of migratory birds. The fundamental principles that underlie the regulations adopted for its enforcement include the abolition of spring shooting, the prohibition of the sale of migratory game birds, and the prescription of definite, reasonable, daily bag limits. Under the terms of the treaty open seasons are restricted to a period not exceeding three and one-half months in any one year.

Protection by restriction on hunting, however, is only one of several possible means of carrying into effect the objects of the international agreement. Its intention can be defeated in spite of such laws if the birds are denied the use of the breeding and resting grounds that they have enjoyed for countless generations. The present outstanding need of our birds is a series of refuges in their accustomed habitat along the flight lanes of their annual migrations. The spread of civilization and consequent commercial developments have made serious inroads into the breeding and feeding grounds of all wild life, especially in the comparatively limited areas suitable for migratory wild fowl. Unwise drainage of many marshes and lakes throughout the country also has destroyed large water areas chiefly suitable for the production of wild life, without compensating benefits.

Reservations of various kinds have been set aside by governmental action from time to time, and some of them directly and some incidentally protect wild life. One of the best known of the latter class is the Yellowstone National Park, established by act of Congress in 1872. Other national parks have been set aside since then, military parks have been established on famous battle fields, and national monuments have been created for the preservation of objects of historic and scientific interest, and on all these, wild life is incidentally protected by the administering agencies.

The Bureau of Biological Survey administers 78 game and bird reservations directly created for the protection of wild life. All are bird refuges and five are big-game preserves. One of the most important of these is the Upper Mississippi River Wild Life and Fish Refuge, administered jointly by the Departments of Agriculture and Commerce. This and the bird refuges at Big Lake, Ark., and at Malheur and Upper Klamath Lakes, Oreg., are among the few refuges now under Federal control that are important as breeding, feeding, and resting grounds for migratory game birds. Another important refuge for migratory birds was authorized by Congress on April 23, 1928, at Bear River Bay, Great Salt Lake, Utah.

The engineering investigations conducted last year by the Bureau of Biological Survey and the Bureau of Public Roads, with the cooperation of western sportsmen who raised the funds expended by the department for that purpose, developed that it is impracticable to improve materially conditions for migratory birds at Malheur Lake, Oreg., and Lower Klamath Lake, Calif.

Increased numbers of migratory wild fowl tax the feeding and carrying capacity of their ever-diminishing range and create urgent problems concerned with their maintenance. Sportsmen and conservationists generally, realizing the necessity for a sustained program in connection with the development and maintenance of wild-fowl breeding and feeding areas throughout the country, have been endeavoring to bring about a system of migratory-bird refuges.

In Alaska the Department of Agriculture has been concerned with the protection of wild life since the first general game law for the Territory was enacted in 1902. The law was revised in 1908, but adequate provision for conservation in Alaska, particularly with reference to land fur-bearing animals, was not made until the passage of the Alaska game law of 1925, which provides for the protection of wild life in the Territory and creates a commission of five resident members, one of whom is the chief representative of the Bureau of Biological Survey in Alaska. Under the guardianship of resident commissioners appointed by the Secretary of Agriculture and the cooperation of the bureau, through representation on the commission, there is an encouraging outlook for the future of Alaskan wild life.

REVIEW OF LEGISLATION OF 1928

With only nine States [1] holding regular legislative sessions this year, modifications in the game laws have been comparatively few. Regulatory changes have been effected both in the United States and Canada.

FEDERAL LEGISLATION

AMENDED MIGRATORY BIRD TREATY ACT REGULATIONS

Three amendments to the Federal regulations on migratory birds have been adopted this year. Those of March 2 prescribed open seasons on gallinules concurrent with those on rails, because of the fact that gallinules migrate generally with rails and are commonly shot as "king rails" in many sections of the country during the rail season. Formerly the seasons on gallinules were the same as those on waterfowl. The Federal regulations under the migratory bird treaty act have always prescribed combined bag limits on rails (except sora) and gallinules, although previously the prescribed seasons on the species were widely separated. The open season on waterfowl, Wilson snipe, and coots in Illinois was restored to the period September 16 to December 31, as the period October 1 to January 15 proved unsatisfactory under conditions in the State.

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[1] New York, Massachusetts, Rhode Island, New Jersey, Virginia, Kentucky, South Carolina, Mississippi, and Louisiana.

Another amendment affecting waterfowl hunting eliminated the restriction on the placing of sinkboxes, or batteries, in coastal sounds and bays, including Back Bay, Princess Anne County, Va., within 700 yards of the shore of the mainland or an island at ordinary high tide, or within 700 yards of another sinkbox, or battery. The provision prohibiting the use of sinkboxes in strictly inland waters in the hunting of migratory waterfowl was not changed.

A departure in the fixing of Federal open seasons was made in reference to doves in South Carolina, Florida, Alabama, Louisiana, and Mississippi, where the open season was divided into two periods, the first during the month of September and the second from November 20 to January 31. Various seasons heretofore have been prescribed for doves in these States, but owing to the fact that the native-bred birds migrate before the arrival of those from the north, no season comprising one consecutive period has been entirely satisfactory, for it either restricted the shooting on native birds or curtailed it on those in the later migrations. The same split season was prescribed for doves in Georgia by the early amendments, but on July 13 it was restored to the period October 16 to January 31. The conflict between the existing State law and the split season on doves operated to shorten the actual legal open season in the State to the period November 20 to January 31, eliminating the opportunity for dove shooting in September and October and the early part of November, as afforded under one or the other season. The amendment restoring the season to the former date will allow the matter to be acted upon by the Georgia Legislature at its 1929 session. Louisiana, desiring a split season on doves, passed a law to that effect, and the Federal amendment in conformity with the new State season was adopted on July 13.

The principal provision of the amendments of July 13 was a general readjustment of the open seasons on woodcock, which were limited to maximum periods not exceeding 31 days. This change was based on information obtained by the Bureau of Biological Survey from inquiries and investigations which indicated that, over its range as a whole, the species is decreasing in numbers. By a later amendment, of August 16, the woodcock season for New Hampshire was changed to harmonize with that in Maine and Vermont. The details of the woodcock seasons will be found on page 8 in the summary of the Federal regulations on migratory birds.

The waterfowl season in Barnstable County, Mass., south and east of the Cape Cod Canal was modified and the period from October 1 to January 15 was prescribed to harmonize with the existing season in the island counties of Dukes and Nantucket.

FEDERAL REFUGES

The migratory bird conservation bill to establish refuges for waterfowl and other migratory birds (S. 1271, H. R. 5467) after a careful revision was reintroduced in the Seventieth Congress and was passed by the Senate on April 18, 1928, after amendment in three fundamental particulars: A direct appropriation of $1,000,000 per annum was authorized in lieu of the financial plan prescribed in the original bill to raise funds to carry out its provisions through the prescription of $1 annual Federal license to hunt migratory birds; it was also modified to eliminate any provision for public shooting grounds on areas acquired thereunder; and the third amendment provided for the State game authorities taking over the enforcement of the law and regulations on the reservations when established, with a provision that the State should be reimbursed from Federal funds for the cost of such enforcement. No action was taken in the House, where the bill is still pending.

Bear River Refuge.—An important act passed by Congress provides for the establishment of a migratory-bird refuge at Bear River Bay, Great Salt Lake, Utah (Public, No. 304, 70th Cong.). This measure authorizes an appropriation of $350,000 to carry out its provisions, including the construction of dikes, ditches, and other improvements necessary to flood the area with fresh water and prevent the great destruction by alkali poisoning of hordes of the migratory wild fowl that annually frequent this section. An appropriation of $200,000 to inaugurate this project was included in the second deficiency bill.

The site of this refuge comprises the greatest wild-fowl area in the Rocky Mountain region and is the heart of the wild-fowl problem of 11 Western States. With the elimination of the death trap, which has existed there for years, the region will become a wild-fowl supply point for the surrounding country, producing vastly increased numbers of the birds. On July 23, 1928, the President issued an order withdrawing from entry public lands in the vicinity of Bear River Bay, Utah, in connection with this project.

Upper Mississippi Refuge legislation.[2]—The joint resolution approved on May 12 (Public Res. 42, 70th Cong.) increasing from $5 to $10 an acre the average price that may be paid for lands in the Upper Mississippi River Wild Life and Fish Refuge should make possible the completion of land purchases for this project. It has been definitely determined that the total land area to be acquired for the refuge will not exceed 160,000 acres, of which about 72,000 acres remain to be purchased. More than 88,000 acres were under control on July 1, including about 14,000 acres of unsurveyed Government islands designated for the refuge by Executive order, 11,000 acres of the national-forest portion of the Savanna Proving Ground, 10,000 acres of State and city lands within the boundaries of refuge, and 53,000 acres that have been purchased or leased or are under contract of purchase by the Federal Government for the project. The additional water area included within the boundaries of the refuge is about 100,000 acres.

An important addition to the Upper Mississippi Wild Life Refuge was completed by the enactment of the resolution approved April 10 (Public Res. 25, 70th Cong.) accepting the gift from James Buell Munn, of New York City, of a tract of 488 acres, together with the buildings and improvements. This area includes an elevation locally known as Pikes Peak, the highest point in the vicinity of McGregor, Iowa, and is important not only as an administrative site but also as a lookout station and a refuge for upland game and birds.

Refuges created by Executive order.—Three refuges have been created by Executive orders since the last bulletin on the game laws was issued. The first comprises a group of marshy islands near the mouth of the Matanzas River, about 15 miles south of St. Augustine, Fla., and formerly a part of the Fort Matanzas Military Reservation. The Pathfinder Bird Refuge, originally created on February 25, 1909, and abolished on August 18, 1922, was reestablished. This refuge is in the area withdrawn for reclamation purposes in connection with the North Platte reclamation project, Wyoming. The third is the Upper Klamath Wild Life Refuge, comprising the sump of Upper Klamath Lake in Oregon and within the reclamation withdrawal for the Klamath irrigation project.

The Executive order of February 25, 1909, reserving Deer Flat Reservoir, Idaho, as a bird refuge, was modified to eliminate certain small areas on the southern and western borders; and the order of February 24, 1908, as modified on April 2, 1909, creating the Mosquito Inlet Bird Reservation in and near the mouths of the Halifax and Hillsboro Rivers, Mosquito Inlet, Fla., has been revoked and the reservation abandoned.

ALASKA REGULATIONS

After consulation with the Alaska Game Commission and on the recommendation of the Bureau of Biological Survey, the Secretary of Agriculture on March 28 adopted amended regulations under the Alaska game law affecting big game in the Territory. The bag limits allowed a nonresident on caribou and moutain sheep were reduced from three to two of each a season. The seasonal limit on large brown and grizzly bears on the Kenai and Alaska Peninsulas and in the Kodiak-Afognak Islands group was reduced from three to two. The season on moose on the Alaska Peninsula south and west of the Kvichak River, Iliamna Lake, and the old Kamishak-Kakhonak Bay portage was closed to permit increase in the few remaining moose in that region. Other amendments related to the sale, under permit of the Alaska Game Commission, of the meat of big-game animals in cooked form in certain portions of the Territory.

OTHER CONSERVATION LEGISLATION

The so-called Leavitt bill (Public, No. 425, 70th Cong.) was enacted authorizing an appropriation of $150,000 to carry out the provisions of the act of May 26, 1926 (44 Stat. 655), to purchase privately owned lands in the Absaroka and Gallatin National Forests to improve and extend the winter-food facilities for elk, antelope, and other big game of the Yellowstone National Park and adjacent land.

Certain other legislation adopted by the Seventieth Congress while not direct measures for the conservation of wild life are nevertheless of considerable importance in that respect, including the so-called forestry research act (Public, No. 466), which authorizes appropriations totaling $150,000 for experiments and investigations in determining the life histories and habits of animals, birds, and other wild life in relation to forestry.

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[2] Full text of the regulations for the administration of the refuge, issued jointly on June 24, 1927, by the Departments of Agriculture and Commerce, will be found in Service and Regulatory Announcement B. S. No. 67, which may be obtained free from the United States Department of Agriculture on request.

Another forestry act that has an important bearing on wild-life conservation is that of April 30 (Public, No. 326) authorizing a three-year acquisition program and carrying appropriations totaling $8,000,000 for the purchase of areas under the Weeks forestry law of March 1, 1911, and its amendments, and the McNary Act of 1924. The law under which the Appalachian forestry system was established authorizes the President to reserve as refuges for wild life suitable areas acquired in that system.

An act approved May 26 (Public, No. 558) authorizes the acquisition, by exchange of public lands, of 1,350 acres along the western boundary of the Yosemite National Park for the protection of park deer.

The act of April 26 (Public, No. 320) accepts the cession by California of exclusive jurisdiction over lands in the Lassen Volcanic National Park and provides for the protection of wild animals therein and for the administration of the park area.

The act approved February 16 (Public, No. 33) established 327,000 acres as the minimum area for the Shenandoah National Park, and confers additional powers on the Department of the Interior in connection with the administration of the Shenandoah and Great Smoky Mountains National Parks.

Public law No. 272 provides that if the State of California within a period of six years acquires either or both of the Calaveras big-tree groves and dedicates them for park purposes, upon the request of the Governor and with the concurrence of the Secretary of Agriculture, the Secretary of the Interior is authorized to issue patent to the State for 1,200 acres of public lands in the Stanislaus National Forest as an addition to the park.

The act of May 12 (Public, No. 373) grants to the State of South Dakota for park purposes 1,280 acres of national-forest lands within the boundaries of the Custer State Park.

CANADIAN REGULATIONS

The Canadian regulations on migratory birds were amended in several particulars, none of which were radical in nature. Waterfowl seasons were shortened two weeks in portions of Alberta and Ontario. The portion affected in Alberta lies south of the Clearwater and Athabaska Rivers, while that in Ontario lies south of the French and Mattawa Rivers and Georgian Bay waters. The season on black brant in the western district of British Columbia was shifted to open two weeks later than formerly.

The close season on cranes, swans, and all shore birds except Wilson snipe, or jacksnipe, and woodcock was continued until 1930 and that on wood duck and eider ducks until 1931, except that eider ducks as heretofore are allowed to be taken during the open season on other waterfowl in Nova Scotia, New Brunswick, Prince Edward Island, Yukon, and Northwest Territories, and in part of the northern portion of Ontario.

An open season from September 15 to 30 was prescribed on band-tailed pigeons in British Columbia with a bag limit of 10 a day, 50 a season. It is provided, however, that live decoys may not be used in the hunting of band-tailed pigeons.

Restrictions were also adopted on the excavation of sunken blinds or the use of such blinds in taking black ducks in certain local areas around Goose Bay and Little River Harbor in Nova Scotia, but provision was made that such blinds may be used if constructed within 25 yards of the channel banks at low water, for the purpose of shooting other species of ducks in the area affected.

Provision was also made to allow an occupant or landowner who finds it impossible to protect crops of cereal grains from depredations of wild ducks to authorize another person to shoot ducks found to be doing serious damage. The person granting such permission to another is required to notify immediately the game commissioner of the Province in which the area is located, giving the name and address of the person authorized to do such killing, and a description of the land on which the ducks are doing damage.

STATE AND PROVINCIAL LEGISLATION

BIG GAME

The legislation affecting big game included that of Kentucky extending the close season on deer and elk until 1932; that of Massachusetts lengthening the open season on deer one week; New Jersey making it illegal to shoot buck deer with horns less than 3 inches long, instead of merely visible above the hair; New York prescribing a two weeks' open season on deer with horns at least 3 inches long, in all sections of the State outside the Adirondack region and the eight counties heretofore open to deer hunting.

Pennsylvania, by regulation of the board of game commissioners, will allow only deer without horns, weighing not less than 50 pounds after entrails are removed, to be killed in the State during the open season this year. Deer hunting will be confined to residents of the State under special $2 licenses in addition to the regular hunting license required by law. The black-bear season, while lengthened two weeks, was restricted to three days each week prior to December 1.

In Canada big game was afforded additional protection in Alberta, British Columbia, Nova Scotia, Ontario, Quebec, Saskatchewan, and Yukon.

In Alberta black bears were given protection and an open season designated. The taking of cubs or bears with cubs was prohibited. British Columbia shortened the season two weeks on buck deer and mountain goat, but lengthened it in the western district two weeks on bear. Ontario shortened the season on big game five days north and 15 days south of the French and Mattawa Rivers. Quebec closed the season throughout the Province on caribou and prohibited the sale of big game, while Saskatchewan closed the season on bull elk, thereby prohibiting elk hunting in that Province. In Nova Scotia the month open season on buck deer was shifted to open two weeks later than formerly, and three counties heretofore closed were opened to deer hunting. Nova Scotia also repealed the provision allowing farmers under special license to kill deer and moose of either sex during the first 10 days of December. In New Brunswick a special $25 license was prescribed for nonresidents hunting bears during April, May, and June, with a limit of two a season. Yukon established a limit on bears of six a season.

UPLAND GAME

The most radical change in the hunting of upland game was that provided by regulation in Pennsylvania in lengthening the season from approximately two weeks to one month on the various species but restricting hunting prior to December 1 to Thursday, Friday, and Saturday of each week. The board also shortened the season on waterfowl two weeks by opening October 15 instead of October 1 as heretofore but did not restrict hunting to certain days of the week.

The season on ruffed grouse was closed in Massachusetts, New York, and North Dakota, and on prairie chickens in Michigan. Saskatchewan closed the Province to the hunting of ptarmigan, ruffed grouse, prairie chicken, and other species of grouse. In Rhode Island the opening date on quail and grouse hunting was deferred until November 1, and daily bag limits were prescribed on ruffed grouse, cock pheasants, and quail. New Jersey extended the close term on quail in 10 counties until 1933.

Squirrels have received additional protection in Virginia by the establishment of daily and seasonal limits, and in Kentucky by the fixing of a limit on the number that may be taken or possessed in a day.

In Virginia the authority heretofore conferred on boards of supervisors to shorten seasons and make other restrictions on the taking of game was transferred to the commission of game and inland fisheries.

WATERFOWL IN VIRGINIA

Virginia enacted a season on waterfowl in harmony with that prescribed by the Federal regulations, thus remedying a previous omission in the State game law.

There was also enacted a special law limiting the number of sinkboxes (batteries) and mat blinds on Back Bay, Princess Anne County, to 50 and 27, respectively, that were actually in operation in 1927–28. Provision is also made that in case a license for a sinkbox (battery) is not renewed by the former owner or holder, it may not be reissued to another until the number on the bay is less than 25, and in the case of mat blinds, less than 11. The fee prescribed for licenses for outfits of the above nature is $100 a season. A license of $50 a season was also prescribed for shore blinds.

HUNTING LICENSES

Hunting-license fees were changed in Kentucky, where the nonresident fee was reduced from $25 to $10.50, and in Virginia, which prescribed a combined hunting, trapping, and fishing license and increased the fee for nonresident licenses from $10 to $15.50. License buttons hereafter must be displayed on outer garments by licensees in Virginia.

MISCELLANEOUS PROVISIONS

In the matter of game-bird protection, Prince Edward Island reenacted its game law, fixed a daily bag limit on partridge, and restricted the sale of resident game to the open season. Saskatchewan increased the fee for a bird license to residents from $1.25 to $1.50; and on Wilson snipe reduced the number that may be taken in a day or season.

A provision was adopted in New Jersey prohibiting the killing of migratory game birds at any time on Shark River or its shores in Monmouth County.

FEDERAL LAWS RELATING TO MIGRATORY BIRDS [3]

Migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916, are as follows:

1. *Migratory game birds:*

(*a*) Anatidae, or waterfowl, including brant, wild ducks, geese, and swans.

(*b*) Gruidae, or cranes, including little brown, sand-hill, and whooping cranes.

(*c*) Rallidae, or rails, including coot, gallinules, and sora and other rails.

(*d*) Limicolae, or shore birds, including avocets, curlews, dowitchers, godwits, knots, oyster catchers, phalaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs.

(*e*) Columbidae, or pigeons, including doves and wild pigeons.

2. *Migratory insectivorous birds:* Cuckoos; flickers and other woodpeckers; nighthawks or bullbats and whippoorwills; swifts; hummingbirds; flycatchers; bobolinks, meadowlarks, and orioles; grosbeaks; tanagers; martins and other swallows; waxwings; shrikes; vireos; warblers; pipits; catbirds and brown thrashers; wrens; brown creepers; nuthatches; chickadees and titmice; kinglets and gnat catchers; robins and other thrushes; and all other perching birds which feed entirely or chiefly on insects.

3. *Other migratory nongame birds:* Auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

OPEN SEASONS UNDER FEDERAL REGULATIONS

Following are the provisions of the Federal regulations, with amendments of March 2, July 13, and August 16, 1928, fixing open seasons on migratory game birds, which seasons are in some instances further shortened by State regulation (for dates during which a person may hunt without violating either Federal regulations or State law, see the open season dates for the various States, beginning on page 11):

Waterfowl (except wood duck, eider ducks, and swans), coot, and Wilson snipe or jacksnipe.—The open seasons for waterfowl (except wood duck, eider ducks, and swans), coot, and Wilson snipe or jacksnipe shall be as follows:

In Maine, New Hampshire, Vermont, Massachusetts (except in Nantucket and Dukes Counties and Barnstable County, south and east of Cape Cod Canal), Ohio, West Virginia, Michigan, Wisconsin, Illinois, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, Colorado, Wyoming, Montana, Nevada, and that portion of Idaho comprising the counties of Boundary, Bonner, Kootenai, Benewah, and Shoshone, the open season shall be from September 16 to December 31;

In New York (except Long Island) the open season shall be from September 24 to January 7;

In that portion of Massachusetts known as Nantucket and Dukes Counties, and Barnstable County, south and east of Cape Cod Canal, and in Rhode Island, Connecticut, Pennsylvania, Indiana, Oklahoma, Utah, Idaho (except in the counties of Boundary, Bonner, Kootenai, Benewah, and Shoshone), California, Oregon, and Washington the open season shall be from October 1 to January 15;

In that portion of New York known as Long Island, and in New Jersey, Delaware, New Mexico, Arizona, that portion of Texas lying west and north of a line beginning on the Rio Grande River directly west of the town of Del Rio, Tex.;

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[3] The full text of the migratory-bird treaty act and regulations affecting birds and game is contained in a separate publication of the department (Service and Regulatory Announcement—B. S. No. 70), which may be obtained from the Secretary of Agriculture, Washington, D. C. Likewise the Canadian regulations may be obtained from the Commissioner, National Parks of Canada, Ottawa, Ontario.

thence east to the town of Del Rio; thence easterly following the center of the main track of the Southern Pacific Railroad through the towns of Spofford, Uvalde, and Hondo; thence to the point where the Southern Pacific Railroad crosses the International & Great Northern Railroad, at or near San Antonio; thence following the center of the track of said International & Great Northern Railroad in an easterly direction, to the point in the City of Austin, where it joins Congress Avenue, near the International & Great Northern Railroad depot; thence across said Congress Avenue to the center of the main track of the Houston & Texas Central Railroad where said track joins said Congress Avenue, at or near the Houston & Texas Central Railroad depot; thence following the center line of the track of said Houston & Texas Central Railroad in an easterly direction through the towns of Elgin, Giddings, and Brenham, to the point where said railroad crosses the Brazos River; thence with the center of said Brazos River in a general northerly direction, to the point on said river where the Beaumont branch of the Sante Fe Railway crosses the same; thence with the center of the track of the said Gulf, Colorado & Santa Fe Railway, in an easterly direction through the towns of Navasota, Montgomery, and Conroe, to the point at or near Cleveland, where said Gulf, Colorado & Sante Fe Railway crosses the Houston, East & West Texas Railroad; thence with the center of said Houston, East & West Texas Railroad track to the point in said line, where it strikes the Louisiana line, *the open season shall be from October 16 to January 31*, and in that portion of Texas lying south and east of the line above described the open season shall be from November 1 to January 31;

In Maryland, the District of Columbia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, and Louisiana, the open season shall be from November 1 to January 31; and

In Alaska the open season shall be from September 1 to December 15.

Rails and gallinules (except coot).—The open season for sora and other rails and gallinules (except coot) shall be from September 1 to November 30, except as follows:

In Massachusetts the open season shall be from September 16 to December 15; and

In Louisiana the open season shall be from November 1 to January 31.

Greater and lesser yellowlegs.—There shall be a continuous close season on greater and lesser yellowlegs until August 16, 1929.

Woodcock.—The open seasons for woodcock shall be as follows:

In Maine, New Hampshire, Vermont, and North Dakota the open season shall be from October 1 to October 31;

In Massachusetts, Rhode Island, and Connecticut the open season shall be from October 20 to November 19;

In New York, New Jersey, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, and Iowa the open season shall be from October 15 to November 14;

In Maryland, the District of Columbia, and Missouri the open season shall be from November 10 to December 10;

In Delaware, Virginia, West Virginia, Kentucky, Arkansas, and Oklahoma the open season shall be from November 15 to December 15; and

In North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Louisiana the open season shall be from December 1 to December 31.

Doves.—The open seasons for mourning doves shall be as follows:

In Delaware, Maryland, Virginia, North Carolina, Tennessee, Kentucky, Ohio, Indiana, Illinois, Minnesota, Nebraska, Kansas, Missouri, Arkansas, Oklahoma, New Mexico, Colorado, Utah, Arizona, California, Nevada, Idaho, Oregon, that portion of Texas lying west and north of a line beginning on the Rio Grande River directly west of the town of Del Rio, Tex.; thence east to the town of Del Rio; thence easterly following the center of the main track of the Southern Pacific Railroad through the towns of Spofford, Uvalde, and Hondo; thence to the point where the Southern Pacific Railroad crosses the International & Great Northern Railroad, at or near San Antonio; thence following the center of the track of said International & Great Northern Railroad in an easterly direction, to the point in the City of Austin, where it joins Congress Avenue, near the International & Great Northern Railroad depot; thence across said Congress Avenue to the center of the main track of the Houston & Texas Central Railroad where said track joins said Congress Avenue, at or near the Houston & Texas Central Railroad depot; thence following the center line of the track of said Houston & Texas Central Railroad in an easterly direction through the towns of Elgin, Giddings, and Brenham, to the point where said railroad crosses the Brazos River; thence with the center of said Brazos River in a general northerly direction, to the point on said river where the Beaumont branch of the Santa Fe

Railway crosses the same; thence with the center of the track of the said Gulf, Colorado & Santa Fe Railway, in an easterly direction through the towns of Navasota, Montgomery, and Conroe, to the point at or near Cleveland, where said Gulf, Colorado & Santa Fe Railway crosses the Houston, East & West Texas Railroad; thence with the center of said Houston, East & West Texas Railroad track to the point in said line, where it strikes the Louisiana line, *the open season shall be from September 1 to December 15;* and in that portion of Texas lying south and east of the line above described the open season shall be from November 1 to December 31;

In South Carolina, Florida, Alabama, Mississippi, and Louisiana the open season shall be from September 1 to September 30 and from November 20 to January 31; and

In Georgia the open season shall be from October 16 to January 31.

BAG LIMITS AND OTHER PROVISIONS UNDER FEDERAL REGULATIONS

Bag limits.—A person may take in any one day during the open season prescribed therefor not to exceed the following numbers of migratory game birds, which numbers shall include all birds taken by any person who for hire accompanies or assists him in taking migratory birds:

Ducks (except wood duck and eider ducks), 25 in the aggregate of all kinds.
Geese, 8 in the aggregate of all kinds.
Brant, 8.
Coots, 25.
Sora, 25.
Other rails and gallinules, 25 in all, but not more than 15 of any one species, other than sora.
Wilson snipe, 20.
Woodcock, 4.
Mourning doves, 25.

No other migratory birds may be taken at any time except under permit for propagating, scientific, or banding purposes, or under an order of the Secretary of Agriculture to prevent injury to agricultural or other interests.

Time of day and methods.—Migratory game birds may be taken on any day during the open season from half an hour before sunrise to sunset with a gun not larger than 10 gauge, fired from the shoulder, with the aid of a dog, the use of decoys, and from a blind or floating device other than an airplane, powerboat, sailboat, any boat under sail, or any floating device towed by powerboat or sailboat, or any sinkbox (battery), except that sinkboxes (batteries) may be used in taking waterfowl in coastal sounds and bays (including Back Bay, Princess Anne County, Va.), and other coastal waters; and the use of an airplane or a powerboat, sailboat, or other floating device for the purpose of concentrating, driving, rallying, or stirring up migratory waterfowl is prohibited.

Possession.—Migratory game birds legally taken may be possessed during the period constituting the open season where killed and for an additional period of 10 days next succeeding such open season, and those coming from a country other than Canada may be possessed in the State into which they are brought only during the open season in that State and such additional time immediately thereafter as may be permitted by both Federal and State laws.

Interstate traffic in game.—Not more than two days' bag limit of migratory game birds may be exported or removed from the State where taken in any one calendar week, and such migratory game birds or parts thereof in transit during the open season may continue in transit such additional time, not exceeding five days, as may be necessary for delivery at destination.

The Lacey Act prohibits interstate shipment by common carrier of wild animals or parts thereof where such animals have been killed or shipped in violation of the laws of the State in which killed or from which shipped, and section 4 of the treaty act likewise prohibits the removal in any manner from one State to another of any wild birds in violation of State laws or which have been illegally taken. All packages in interstate commerce containing game animals or nonmigratory game birds, or parts thereof, must be marked to show the names and addresses of the consignor and consignee and the nature of the contents, and packages containing migratory birds must be marked with such addresses and the number and kind of such birds therein.

Sale.—The Federal law prohibits the sale of all migratory birds throughout the United States except birds taken for scientific or propagating purposes and waterfowl raised on farms or preserves under permit from the Secretary of Agriculture.[4]

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[4] See footnote 3, p. 7.

Alaskan exceptions.—In Alaska, Eskimos and Indians may take for the use of themselves and their immediate families, in any manner and at any time, and possess and transport auks, auklets, guillemots, murres, and puffins and their eggs for food and their skins for clothing.

Permits for propagation and other purposes.—Under appropriate permit from the Secretary of Agriculture, and when allowed by State law, migratory waterfowl may be captured at any time for propagating purposes and migratory birds may be taken for scientific purposes, including banding. The Secretary of Agriculture may also issue orders permitting the killing of migratory birds to prevent serious injury to agriculture or other interests.

Further restrictions by States.—The States may shorten the open seasons fixed by Federal regulations on migratory birds, reduce the bag limits, prohibit export, restrict the period during which migratory birds may be possessed in close season, or make other laws or regulations to give further protection to such birds, but may not lengthen the open season, increase the bag limit, permit sale, or otherwise lessen the protection afforded by Federal law.

SUMMARY OF LAWS RELATING TO SEASONS, LICENSES, LIMITS, POSSESSION, INTERSTATE TRANSPORTATION, AND SALE

Game laws and information.—Persons are advised to obtain from State game commissioners the full text of game laws in States where hunting is contemplated. (See list on p. II, back of title-page.) They should also obtain information from the Bureau of Biological Survey or State game departments[5] regarding the existence of Federal and State game and bird refuges in areas in which they contemplate hunting, as the location of refuges and the restrictions regarding hunting thereon are not included in this bulletin.

Open season dates.—The dates of open seasons for migratory game birds shown under the various States and Provinces are the times when these birds may be hunted without violating either State or provincial laws or Federal or Canadian regulations.

In stating the open season[6] the plan has been followed of including the first and last days thereof. The difficulty of attaining absolute accuracy in a statement of the seasons is great, but summaries have been submitted to the proper State or Provincial game officials for correction and approval, and the dates as stated are believed to be free from material errors.

Permanent close seasons.—Species (including migratory game and nongame birds protected throughout each year by Federal regulations) on which the season is closed for a term of years or for an indefinite period are grouped under the term "No open season." Provisions of State laws prohibiting hunting at night, between sunset and sunrise, or during certain hours are not included.

Rest days.—In some States certain days of the week constitute rest days or close seasons during the time when hunting is permitted. Hunting on Sunday is prohibited in all States and Provinces east of the one-hundred and fifth meridian, except Illinois, Louisiana, Michigan, Rhode Island, Texas, Wisconsin, and Quebec. Mondays constitute a close season for waterfowl locally in Maryland and North Carolina; and certain other week days for waterfowl in several favorite ducking grounds in Maryland, Virginia, North Carolina, and Florida. In Nevada the hunting of migratory waterfowl is prohibited on Monday, Tuesday, Thursday, and Friday of each week during the open season. In Pennsylvania, prior to December 1, hunting is permitted only on Thursday, Friday, and Saturday of each week, except on waterfowl. In Oklahoma quail may be hunted only on Monday, Wednesday, and Friday of each week during the open season, and on Thanksgiving Day and Christmas and New Year's Days or the preceding Saturdays, if they fall on Sundays. Hunting is prohibited when snow is on the ground in New Jersey, Delaware, and Virginia, and locally on all game except waterfowl in Maryland.

Possession.—The provision of the Federal regulations permitting the possession of migratory game birds during the first 10 days of the close season has been considered in connection with State laws, and when migratory game birds may be possessed during any part of the close season without violating either the

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[5] See list on page II (back of title-page). A full list of names and addresses of officials and organizations concerned with the protection of birds and game will be found in Misc. Pub. No. 30, U. S. Dept. Agr., 1928.

[6] For open seasons on fur-bearing animals for the season 1928–29 see Farmers' Bulletin No. 1576.

Federal regulations or State laws it has been stated under the heading "Bag limits and possession."

Possession of nonmigratory game during the close season is generally prohibited by State laws, but when an extension of a few days, or a special season, is provided for either possession or sale, attention is called thereto.

Interstate transportation.—Under the heading "Interstate transportation," in addition to statements of restrictions on removal of game from the State in which it is taken, information has been included concerning the importation and possession by sportsmen for personal use of game legally killed outside the State and legally exported from the place where taken. In the absence of specific State legislation to the contrary, or where legislation prohibits possession of game in close season, it has been construed that sportsmen may bring home their game and possess it in their State in the same manner as if it had been killed there.

Propagated and imported game.—For laws concerning traffic in imported game and game raised in captivity under Federal and State licenses, see pages 43 to 46.

STATE LAWS

ALABAMA

Open seasons: [7]	*Dates inclusive*
Deer (male)	Nov. 1–Dec. 31.
Bear	Nov. 1–Feb. 28.
Squirrel (black, gray, fox)	Nov. 1–Jan. 31.[8]
Quail (partridge)	Nov. 20–Feb. 20.
Wild turkey gobbler	Dec. 1–Mar. 31.
Turtle dove	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Duck, goose, brant, Wilson snipe, coot (mud hen)	Nov. 1–Jan. 31.
Woodcock	Dec. 1–Dec. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Ruffed grouse (pheasant), introduced pheasant, or other introduced game bird (1931); does, turkey hens, swans, wood duck, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, loons, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting licenses: Nonresident or alien, $25. Resident: State, $3; county, $1. Trapping (bears and other fur-bearing animals), $15 for first trap and $2.50 for each additional trap. Issued by probate judges. Landlords and members of families may hunt or trap on own land during open season without license. Written permission required for hunting or trapping on land of another.

Bag limits and possession: One buck a day or in possession, 5 a season; 1 turkey gobbler a day or in possession, 10 a season; 10 squirrels a day or in possession; 15 quail a day or in possession; 8 each of geese and brant a day, 25 of each in possession; 20 Wilson snipe a day, 25 in possession; 25 each of doves, ducks, coots, and sora a day or in possession; 25 in all of rails (except sora) and gallinules a day, but not more than 15 of any one species, 25 each in possession; 4 woodcock a day, 25 in possession. Possession of migratory game birds permitted during first 10 days of close season; other game during first 5 days.

Interstate transportation: Export of all protected game prohibited, except that a nonresident licensee may take with him, openly, game he has lawfully killed, but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited.

ALASKA

Open seasons: [9]	*Dates inclusive*
Bull moose,[10] caribou (see exceptions), mountain goat [10]	Sept. 1–Dec. 31.
Exceptions: Caribou north of 68th parallel and in drainage of Buckland, Kobuk, Noatak, and Selawik Rivers, fur district 3	Sept. 1–Mar. 31.
In fur district 2, north summit Alaska Range	Aug. 1–Dec. 31.
Deer (male, with horns not less than 3 inches above skull) east of longitude 141° only (southeastern Alaska)	Sept. 1–Nov. 30.
Mountain sheep (ram)	Aug. 20–Dec. 31.[10]
Bear (large brown and grizzly)	Sept. 1–June 20.[11]
Black bear (fur animal—including its brown and blue, or glacier bear, color variations), in fur district 1	Oct. 1–May 31.
In fur district 2:	
North, summit Alaska Range and Ahklun Mountains	No close season.
South	Sept. 1–June 20.[11]
Polar bear in fur districts 2 and 3, and black bear in fur district 3, north of parallel 68	No close season.
Grouse, ptarmigan	Sept. 1–Feb. 28.
Duck (except eider duck), goose, brant, Wilson snipe or jacksnipe	Sept. 1–Dec. 15.

No open season: Buffalo; calf, yearling, and cow moose; fawns and doe deer; lambs and ewes; mountain-goat kids; fawns of caribou; swans, eider ducks, rails, coot, cranes, auklets, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except Wilson snipe or jacksnipe).

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[7] *Alabama*: Hunting prohibited on all State lands.

[8] Squirrels may be killed at any time on own premises when destroying property.

[9] *Alaska*: All hunting is prohibited in Mount McKinley National Park, Katmai and Glacier Bay National Monuments, and, except under permit of the Secretary of Agriculture, in Aleutian Islands Reservation (including Unimak Island) and other national bird and animal reservations, and on Kruzof and Partofshikof Islands. An Indian, Eskimo, or half-breed who has not severed his tribal relations, and an explorer, prospector, or traveler may take animals or birds other than migratory birds (except Eskimos and Indians may take auks, auklets, guillemots, murres, and puffins, and their eggs) in any part of Territory at any time for food when in absolute need of food and other food is not available, but he shall not ship or sell any animal or bird or part thereof so taken.

[10] Unlawful to hunt moose on Alaska Peninsula south and west of Kvichak River, Iliamna Lake, and portage from Kamishak Bay to Kakhonak Bay; and mountain sheep or mountain goats on Kenai Peninsula east of longitude 150° (5 miles east of Stalter place on Kenai River); and mountain goats on Baranof and Chichagof Islands.

[11] Large brown or grizzly bears may be killed when about to attack or molest persons or property, or when found within one-half mile of residence or human habitation. See "Bag limits and possession" for limit on black bears.

Hunting licenses: Nonresident citizen: General, $50; small game, $10; nonresident big-game hunter must be accompanied by registered guide except in fur district 3; licenses issued by commissioners, wardens, and special agents. Resident, $2 (trapping license required for taking black bear, which are fur animals under the law; not required of native-born Indians, Eskimos, or half-breeds who have not exercised the right of franchise or severed their tribal relations). Alien, $100 (special license required to hunt or possess firearms); issued by commission. Licensed hunters, within 30 days after expiration of license, must report to commission number and kind of each species of birds or animals taken.

Guide, $10 (issued only to resident citizens or resident native Indian or Eskimo); issued by commission. Guide must report to commission after each hunting trip.

Shipping licenses: Resident (export for mounting and return), $1 for each trophy; resident removing from Territory, $5 for each trophy. Issued by commission or collector of customs.

Bag limits and possession: Caribou, nonresident 2 a season; resident, 5, not more than 2 of which may be taken south of summit of Alaska Range and Ahklun Mountains; mountain sheep, nonresident, 2, resident, 3, a season, of which not more than 2 may be taken south of Arctic Circle; caribou legally taken north Alaska Range and Ahklun Mountains and mountain sheep north Arctic Circle may be transported and possessed south of such areas by person killing them; 1 moose, 3 deer, 3 goats a season or in possession; 3 in all of large brown and grizzly bears a season or in possession, except on Kenai Peninsula south of Portage Creek and Passage Canal, on the Kodiak-Afognak Islands Group, and on Alaska Peninsula south and west of Kvichak River, Iliamna Lake, and portage from Kamishak Bay to Kakhonak Bay, 2 in the aggregate; black bear in fur district 2, south of Alaska Range and Ahklun Mountains, 2 during September. Number of game animals in excess of season limit may be possessed north of summit of Alaska Range and Ahklun Mountains under permit of commission; 15 grouse, 25 ptarmigan, but not more than 25 in all of grouse and ptarmigan a day; 25 ducks, 8 geese, 8 brant a day, 75 waterfowl in possession; 20 Wilson snipe a day. Migratory game birds legally taken may be possessed during open season and 10 days thereafter, but not more than 75 in all of waterfowl may be possessed at one time. Game animals, grouse, ptarmigan, the hides, heads, and feet of game animals or articles made therefrom; and the skins and feathers of game birds legally taken during open season may be possessed and transported at any time within the Territory, and shed or weathered antlers of deer, moose, or caribou may be possessed and transported within or out of the Territory at any time without a license.

Interstate transportation: Nonresident citizen or nonresident alien licensee may export one moose, three deer, two caribou, two mountain sheep, three mountain goats, and three in all of large brown and grizzly bears (2 brown and grizzly bears if killed in restricted areas on Kodiak-Afognak Islands group or Kenai and Alaska Peninsulas), killed by himself, under license coupon and affidavit that he has not violated the game laws; that the big-game animal or part thereof he desires to ship has not been purchased or sold and is not shipped for purpose of being sold; that he lawfully killed the animal and is the owner of the part thereof that he desires to ship; and, if the shipment contains caribou or sheep or parts thereof, whether such animals were killed north or south of the Alaska Range and Ahklun Mountains or the Arctic Circle, respectively.

A nonresident may possess and transport at any time within or out of the Territory skins and feathers of game birds and articles manufactured from the hides or hoofs of moose, caribou, deer, or goats legally taken. Any person may without a license export shed or weathered antlers of moose, caribou, or deer.

Resident may export for mounting and return in any one year, but not for sale, two heads or trophies of each species of game animal legally killed by himself under shipping license (fee, $1 for each trophy).

A citizen of the United States who has been a resident for at least two years and who is removing his residence from the Territory may export trophies of game animals legally acquired by him under shipping license (fee, $5 for each trophy).

All shipments must be marked with the names and addresses of consignor and consignee and the number of each kind of game contained therein.

Sale: Sale of all protected game prohibited, except that the meat of caribou may be sold by the person killing it, but such meat may not be resold north of summit Alaska Range-Ahklun Mountains except in cooked form, nor south of said summit except in cooked form and then only at road houses having permits from the commission; moose, grouse, and ptarmigan legally killed may be bought and sold at any time north of summit of Alaska Range and Ahklun Mountains, but no person other than the one who killed them may sell them except in cooked form for human food; but the meat of moose, grouse, or ptarmigan may not be sold or served by restaurants, road houses, or public or other eating houses located within 5 miles each side of the center line of the Alaska Railroad and its branches; number of animals in excess of season limit allowed in possession under permit of commission. The meat of animals or birds so sold shall not be transported to or possessed in any other part of the Territory. No game animal, game bird, or parts thereof shall be sold to or bought by the owner, master, or employee of any coastal or river steamer or commercial power or sail boat; unlawful to take or possess for serving or to serve any game animal, game bird, or part thereof in any dining car, commercial mess house operated by a cannery, railroad, or contractor, or in any other commercial mess house or other place maintained for serving food regularly to employees thereof, or to serve such game to an employee of any coastal or river steamer or commercial power or sail boat, or for an employee of a railroad, cannery, mine, contractor, or coastal or river steamer or other commercial power or sail boat to possess such game in a dining car or commercial mess house, or in the galley or dining room of any such boat.

Any person may without a license buy and sell at any time in the Territory the feathers of wild ducks and geese, lawfully killed or seized and condemned by Federal game authorities, for use in making fishing flies, bed pillows, mattresses, and similar commercial purposes, but not for millinery or ornamental purposes; the hides or parts of moose, caribou, deer, and mountain goats legally taken during the open season; shed antlers of caribou, moose, and deer; and the skins and feathers of eagles, crows, hawks, owls, ravens, and cormorants.

ARIZONA

Open seasons:[12]	*Dates inclusive*
Deer (male), wild turkey	Oct. 1–Nov. 1.
Quail (except bobwhite)	Oct. 15–Dec. 31.
Mourning dove	Sept. 1–Dec. 15.
White-winged dove	July 15–Dec. 31.
Duck, goose, brant, Wilson snipe, coot	Oct. 16–Jan. 31.
Rail and gallinule, other than coot	Oct. 16–Nov. 30.

No open season: Does, spotted fawns, elk, antelope, mountain sheep, mountain goat, peccary or javelina (wild hog), bobwhite, grouse, pheasant, swans, bitterns, little brown and sand-hill cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except Wilson snipe or jacksnipe).

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[12] *Arizona:* Animals or birds (except migratory birds) that become seriously injurious to agriculture or other interests may be killed under regulations of the State game warden.

Hunting and fishing licenses: Nonresident or alien: Game and fish, $20; birds (except turkeys) and fish, $10. Not issued to applicant under 12 years of age. Resident: Game and fish, $1.25.

Issued by game warden, designated deputies, and clerk board of supervisors.

American-born resident under 17 years of age may hunt without license, if accompanied by holder of a general license.

Bag limits and possession: One deer, 2 turkeys a season; 20 ducks, 8 geese, 20 Wilson snipe, 20 coots, and 20 rails, but not more than 15 of any one species of rails (other than sora) and gallinules, and not more than 20 in all of waterfowl, Wilson snipe, rails, gallinules, and coots a day or in possession; 20 quail, and 25 doves and white wings a day or in possession. Possession of rails and gallinules permitted during first 10 days of close season; other game during first 5 days thereof.

Interstate transportation: Export of all protected game prohibited.

Possession of game prohibited without a hunting license. Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited.

ARKANSAS

Open seasons:	*Dates inclusive*
Male deer (with horns plainly visible above the skull), turkey gobblers (gobblers also Apr. 1–Apr. 30)	Nov. 12–Nov. 17. Dec. 20–Jan. 1.
Squirrel	May 15–June 15. Oct. 1–Jan. 1.
Quail or partridge (bobwhite)	Dec. 1–Jan. 31.
Duck, goose, brant, Wilson snipe, coot	Nov. 1–Jan. 31.
Woodcock	Nov. 15–Dec. 15.
Dove	Sept. 1–Dec. 15.
Gallinule	Nov. 1–Nov. 30.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.

No open season: Does, fawns, and wild-turkey hens; bear, prairie chicken, grouse, pheasant (1931); swans, wood ducks, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, loons, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15; fish, general, $5; special 15-day (trip), $1.10; resident: Game, $1.10; fish, $1.10. For dog in hunting, $1.50. Issued by State game and fish commission and circuit clerks. Resident license not required of person under 18 years of age. License not required for hunting rabbits, squirrels, or predatory birds and animals or of a person hunting on his own premises. Hunting prohibited on inclosed lands without consent of owner.

County licenses.—Chicot County: Nonresident of State, $50; resident of State: All game, $5.25; game (except deer and turkey), $2.25. Dog (for deer or quail hunting), $1.10. *Desha County*: Nonresident of State, $50; resident of State: All game, $2.50; game (except deer and turkey), $1.10. Dog (for deer or quail hunting), $1. License not required of resident under 16 in Chicot and Desha Counties.

Bag limits and possession: Two deer, 2 turkeys a season; 8 squirrels, 12 quail, 25 doves, 15 ducks, 8 geese, 8 brant, 4 woodcock, 12 Wilson snipe, 15 in all of rails, coots, and gallinules, a day or in possession. Two days' limit of squirrels, quail, or ducks may be possessed at one time, except while in the field hunting or while returning from a hunt of one day's duration. Possession of migratory game birds permitted during first 10 days of close season.

Interstate transportation: Export of all game prohibited; provided a nonresident, under each of 3 tags attached to his license may ship out 1 day's limit of game; and he may carry out at one time not more than 1 day's limit, but not more than 2 days' limit may be removed from State in any 1 calendar week; specimen of game may be exported by any person under permit to be mounted, tanned, or made into wearing apparel.

Game taken outside of State and legally exported may be possessed in State at any time.

Sale: Sale of all protected game prohibited.

CALIFORNIA [13]

Open seasons:	*Dates inclusive*
Male deer (except spike bucks):	
In districts 1, 4, 4½, 4¾, 23, 24, 25, and 26	Sept. 16–Oct. 15.
In district 1½	Sept. 1–Oct. 15.
In district 1¾ (mule deer must have more than two branches to each antler)	Sept. 16–Oct. 15.
In districts 2, 2½, and 3	Aug. 1–Sept. 14.
Bear (black, brown) (see exception)	Nov. 15–Feb. 28.
Exception: In districts 1, 1½, 2, and 2½	No close season.
Cottontail and brush rabbits,[14] mountain, valley, and desert quail (see exception)	Dec. 1–Dec. 31.
Exception: Rabbits in district 4¾	No close season.
Mountain and valley quail, district 1½	Nov. 1–Dec. 31.
Grouse	Sept. 15–Oct. 14.
Sage hen	Aug. 1–Aug. 15.
Dove (see exception)	Sept. 1–Sept. 30.
Exception: In districts 4, 4½, 4¾	Sept. 1–Oct. 31.
Duck, goose, brant, Wilson snipe or jacksnipe, coot (mud hen)	Oct. 1–Jan. 15.
Gallinule	Oct. 1–Nov. 30.

No open season: Doe, spike buck, fawn, elk, antelope, sheep; tree squirrel; sierra hare; pheasant, introduced quail or partridge, turkey, rail, plovers, yellowlegs, swans, wood duck, eider ducks, auklets, bittern, little brown, sand-hill, and whooping cranes, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, band-tailed pigeons, puffins, shearwaters, terns, and all shore birds (except Wilson snipe or jacksnipe).

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[13] *California*: Of the 66 fish and game districts created under the act of 1917, as amended in 1919, 1921, 1925, and 1927, nine (1, 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾) are properly hunting districts; 14, 15, 23, 24, 25, and 26 are fishing districts but are open to hunting; of the other 51 districts, 32 are game refuges and 19 are commercial fishing districts.

District 1 comprises the eastern half of the Sacramento and San Joaquin Valleys, including all counties not included in districts 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾.

District 1½ comprises the counties of Del Norte, Siskiyou, and Humboldt.

District 1¾ comprises Modoc and Lassen Counties.

District 2 comprises that part of the State south of Humboldt and Tehama Counties, west of the Sacramento River and north of San Francisco Bay, including the counties of Glenn, Colusa, Yolo, Solano, Napa, Lake, Sonoma, and Marin, and that portion of Mendocino County not included in district 2½.

District 2½ comprises townships in Mendocino County bordering on Pacific Ocean (except townships 11 north, ranges 15 and 16 west) and townships 13, 14, 15, 16, 17, and 18 north, range 16 west.

District 3 comprises the region around the southern portion of San Francisco Bay and the coast counties south of the Golden Gate as far as Ventura, including the counties of Contra Costa, Alameda, San Mateo, Santa Clara, San Francisco, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, and Ventura; also San Benito and western half of San Joaquin, Stanislaus, Merced, Fresno, Kings, and Kern Counties.

District 4 comprises counties in southern California, namely, Los Angeles, Orange, Riverside, and San Bernardino.

District 4½ comprises counties of Mono and Inyo.

District 4¾ comprises San Diego and Imperial Counties.

Districts 23, 24, 25, and 26, all located in district 1, are as follows:

District 23 comprises the drainage area of Lake Tahoe and the Truckee River in the counties of Placer and Eldorado.

District 24 comprises the drainage area of Silver, Twin, Blue, Meadow, and Wood Lakes in the counties of Alpine and Amador.

District 25 comprises the drainage area of Lake Almanor in the counties of Plumas and Lassen.

District 26 comprises Sixty Lake Basin, part of Rae Lake, and to the south fork of Woods Creek in Fresno County.

[14] Owner or tenant, or person holding written permission from owner or tenant, may kill rabbits on own premises at any time, but rabbits killed in close season may not be shipped or sold.

Hunting and fishing licenses: Game: Nonresident, $10; alien, $25 (except those with first papers, fee $10); fish: Nonresident, $3; alien, $5; resident: Game, $2 (resident, under 18, $1); fish, $2. Fishing license not required of persons under 18 years of age. To veterans of Civil War, issued free of charge. Issued by commissioners and county clerks. Unlawful to hunt in inclosure of another without permission of owner. Deer-tag license, $1; commercial club, citizen owner, $25; alien owner, $100; citizen operator, $5; alien operator, $25.

Bag limits and possession: Two deer a season (except in district 1¾, one only); 15 cottontail or brush rabbits a day, 30 a week; 4 grouse a day, 8 a week; 4 sage hens a day, 8 a week; 10 mountain quail a day, 20 a week; 15 valley or desert quail a day, 30 a week; 20 Wilson snipe or jacksnipe a day, 50 a week; 15 mourning doves a day, 30 a week; 25 ducks a day, 50 a week; 8 geese (honkers) a day, 24 a week; 8 brant a day, 24 a week; 25 coots (mud hens), but not more than 15 gallinules a day, 50 mud hens a week.

Possession in excess of daily limit prohibited. Persons killing deer must retain in possession during open season and 10 days thereafter the skin and the portion of head bearing horns. One day's limit of game birds or animals may be possessed during first 5 days of close season.

Interstate transportation: Export of all protected game prohibited. All shipment by parcel post prohibited.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of deer meat and hides, tree squirrels, and game birds prohibited. Hides of deer taken in a foreign country and cottontail and brush rabbits taken during open season may be sold.

COLORADO

Open seasons:	*Dates inclusive*
Deer (having horns with two or more prongs on each horn)	Oct. 12–Oct. 15.
Rabbit, hare	Unprotected.
Prairie chicken	Sept. 15–Oct. 1.
Mountain and willow grouse	Oct. 1–Oct. 15.
Sage chicken	Aug. 1–Aug. 15.
Duck, goose, brant, coot, Wilson snipe or jacksnipe	Sept. 16–Dec. 31.
Sora and other rails and gallinule (except coot)	Sept. 1–Nov. 30.

No open season: Elk, antelope, sheep, does, fawns, Abert, black or tufted-eared squirrel, quail (bobwhite and crested), pheasant,[15] dove (1930); doe, partridge, ptarmigan, wild turkey, swans, wood duck, eider ducks, bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, jaegers, loons, band-tailed pigeon, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Big game, $25; small game, $5; fish, $3. Resident: Big game, $5; small game and fish, $2. No person under 18 is permitted to hunt big game. Fishing license not required of boys under 16 or of women. Children under 12 not permitted to hunt except on own premises or those of parent or guardian. Guide, $5. Issued by commissioner, county clerks, and other agents. Unlawful to hunt in any inclosure not public land without consent of owner. Unlawful to shoot game from public highway.

Unnaturalized foreign-born residents not permitted to hunt or to own or possess shotgun, rifle, or pistol.

Bag limits and possession: One deer a season, coupon required; prairie chickens, 8 a day or in possession; sage chickens, 8 a day or in possession; and mountain and willow grouse, 8 in all a day or in possession; 25 ducks, 8 geese, 8 brant, 15 Wilson snipe, 25 sora, 15 in all of other rails, coots, and gallinules a day or in possession. Persons under 12 years of age limited to half this number of birds. Possession permitted during first 5 days of close season. Commissioner may issue permit authorizing storage, possession, and use of game for 90 days after close of open season (except possession of migratory birds limited to 10 days after close of season).

Interstate transportation: Export of all protected game is prohibited; provided, birds, not exceeding the numbers allowed in possession, may be exported under permit from game commissioner (fee, 25 cents for each bird) if permit be attached and packages plainly marked so as to show nature of contents, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week; edible portion of deer may be exported under $5 permit from the commissioner.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. Importer must obtain from State game and fish commissioner a certificate, fee $1, to import game.

Sale: Sale of all game taken in State prohibited, but game (except migratory birds) coming from without State may be sold under license by indorsement of shipping invoice to purchaser.

CONNECTICUT

Open seasons:[16]	*Dates inclusive*
Deer [17]	
Hare, rabbit (except European, Belgian, or German hare and jack rabbit, no close season)	Nov. 1–Dec. 15.
Gray squirrel, ruffed grouse, pheasant, male only	Oct. 8–Nov. 23.
Woodcock	Oct. 20–Nov. 19.
Duck, goose, brant	Oct. 1–Jan. 15.
Coot (mud hen)	Oct. 1–Dec. 31.
Wilson or English snipe	Oct. 1–Nov. 30.
Gallinule	Oct. 1–Nov. 30.
Rail, other than coot and gallinule	Sept. 12–Nov. 30.

No open season: Quail (Oct. 8, 1929); Hungarian partridge (Oct. 8, 1930); pheasant hen, dove, swans, wood duck, eider ducks, auks, bitterns, fulmars, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $10.25; game and fish, $11.25; fish, $3.25 (resident of State charging fee in excess of $3.25 pays same fee in Connecticut). Resident citizen: Game, $2.25; game and fish, $3.75; fish, $2.25. Issued by city, town, or borough clerk. Hunting license not issued to persons under 16, and fishing license not required of such persons. Resident and his children may hunt or fish during open season without license on land on which he is actually domiciled, if such land is not used for club, shooting, or fishing purposes. Licensee must report amount of game killed, and must wear license button on outer garment. Alien: Not permitted to hunt; fish, $3.25. Taxidermist, $5. Nonresident or alien who owns real estate assessed at not less than $500 or lineal descendant of such nonresident or alien pays same fee as resident for fishing license.

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[15] *Colorado*: Pheasants damaging crops may be killed or trapped under permit of commissioner.

[16] *Connecticut*: Governor may suspend open seasons during time of drought.

[17] Owners of agricultural lands, member of family, or employee may kill deer with a shotgun or, under permit, with a rifle, at any time on such lands when deer are damaging fruit trees or growing crops, but such killing or wounding must be reported to the commissioners within 12 hours.

Bag limits and possession: Five gray squirrels a day, 30 a season; 3 hares or rabbits a day, 30 a season; 4 woodcock a day, 36 a season; 3 ruffed grouse a day, 21 a season; 2 pheasants a day, 15 a season; 25 ducks, 8 geese, 8 brant a day; 10 Wilson snipe; 25 sora, and 15 in all of other rails, coots, mud hens, and gallinules a day. Possession of more than daily bag limit of game prima facie evidence of violation. Resident may possess during first 10 days of close season, for his own use and not for sale, game lawfully taken.

Interstate transportation: Export of all protected game prohibited, provided a licensee under permit may export game lawfully killed and possessed, when tagged to show name, address, and license number of shipper, if not for sale; but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. Importer must obtain from superintendent of fisheries and game a permit to import game.

Sale: Sale of all protected game prohibited.

DELAWARE

Open seasons:[18]	*Dates inclusive*
Rabbit, hare, quail, partridge	Nov. 15–Dec. 31.
Squirrel (fox, black, gray)	Sept. 1–Oct. 15.
Dove (see exception)	Sept. 1–Dec. 15.
Exception: In New Castle County	Sept. 1–Dec. 1.
Woodcock	Nov. 15–Dec. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Oct. 16–Jan. 31.
Rail and gallinule other than coot	Sept. 1–Nov. 30.

No open season: Hungarian partridge or pheasant, swans, wood duck, eider ducks, reedbirds, bitterns, sand-hill crane, grebes, gulls, herons, loons, murres, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $10.50; fish, $5 (not required in Delaware River or Bay). Resident: Game and fish, $1.10 (required outside county of residence). Issued by commission. Resident landowner may hunt or fish during open season on own land without license. Unlawful to hunt on land of another without permission from owner or occupant. Fishing license not required of certain excursionists. Nonresidents who own or lease property at seaside summer resorts and their relatives, friends, and patrons sojourning at such resorts may fish for nongame fish and hunt without license during open season, between June 1 and September 30. Nonresident licensees must wear license-plate or button on outer garment.

Bag limits and possession: Six in all of rabbits, hares, and squirrels, 20 ducks, 8 geese, 8 brant, 20 Wilson snipe, 4 woodcock, 25 coots, 25 sora, 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, and not more than 50 in all of sora and other rails combined; 12 birds of any other species a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof.

Interstate transportation: Export of rabbit, squirrel, quail, partridge, dove, woodcock, goose, and brant is prohibited, provided holder of license may export, open to view, 10 rabbits, 10 squirrels, 50 rails, and 20 birds or fowl of any other species a week, lawfully killed, by himself under affidavit that the game is not for sale. Resident may export ducks and snipe. In no event, however, may a person export more than two days' limit of migratory birds in any one calendar week.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited, provided a resident may sell in his own county 20 rabbits a season, lawfully taken by him. Rabbits coming from without State may be sold from November 15 to December 31.

DISTRICT OF COLUMBIA[19]

Open seasons:	*Dates inclusive*
Deer meat (sale or possession)	Sept. 1–Jan. 1.
Rabbit (except English rabbit, Belgian hare), squirrel (sale or possession)	Nov. 1–Feb. 1.
Marsh blackbird	Sept. 1–Feb. 1.
Duck, goose, brant, Wilson snipe, coot	Nov. 1–Jan. 31.
Woodcock	Nov. 10–Dec. 10.
Rails and gallinule	Sept. 1–Nov. 30.

No open season: Dove, swans, wood duck, reedbirds, bitterns, grebes, gulls, herons, loons, murres, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Bag limits and possession: Twenty-five ducks, 8 geese, 8 brant, 20 Wilson snipe, 4 woodcock, 25 coots, 25 sora, 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; quail, November 1 to March 15; ruffed grouse or pheasant (except English or other imported pheasants raised in inclosures, possession unrestricted), and wild turkey, November 1 to December 26; prairie chicken (pinnated grouse), September 1 to March 15.

Interstate transportation: Export of migratory game birds in excess of two days' bag limit in any one calendar week prohibited.

Migratory game birds taken outside of District and legally exported may be possessed during open season where taken and first 10 days of close season. Other game may be possessed during open season in District.

Sale: Sale of all game birds prohibited. Deer, rabbit, and squirrel may be sold during open season.

FLORIDA

Open seasons:	*Dates inclusive*
Deer (male)	Aug. 1–Aug.31.[20] Nov. 20–Dec. 31.
Cat squirrel, wild turkey, dove (see exception)	Nov. 20–Jan. 31.
Exception: Dove, also open in Broward, Dade, and Monroe Counties	Sept. 1–Sept. 30.
Quail	Nov. 20–Feb. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Nov. 20–Jan.31.[21]
Rail or marsh hen, other than coot and gallinule	Sept. 15–Nov. 30.
Gallinule	Nov. 20–Nov. 30.

No open season: Does, gray, black, or fox squirrels (1932); ruffed grouse, introduced pheasants, and other foreign game birds; swans, wood duck, reedbirds, bitterns, sand-hill and whooping cranes, gannet, grebes, gulls, herons, jaegers, loons, petrels, shearwaters, terns, woodcock, and all other shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $25.50 (State); fresh-water fish, $5.50 (State), $2.50 (county license). Resident: Game, $10.50 (State); $5.50 (county other than county of residence); $2.25 (county of residence); fresh-water fish, $1.50 (not required in county of residence). Duplicate license, fee 50 cents. Deer license, $1.25 (required in addition to regular hunting license). Issued by county judge. License not required of person under 15 years of age, nor of resident Confederate veteran who is entitled to State pension. Guide, $10; alien, $50; issued by State game commissioner. Boats (renting for hunting or fishing): Under 18 feet in length, $2.50 each; 18 to 21 feet, $4 each; 21 to 25 feet, $15 each; over 25 feet, $25 each; issued by State game commissioner. Licensee must report to State game commissioner within 10 days after close of season number and kind of game taken.

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[18] *Delaware:* Minors under 15 years of age not permitted to hunt game with shotgun or rifle unless accompanied by an adult lawfully hunting.

[19] *District of Columbia:* Hunting prohibited in District by act of June 30, 1906, except on the marshes of the Eastern Branch above Anacostia Bridge and below the Aqueduct Bridge on the Virginia side of the Potomac, but in these areas no birds may be shot within 200 yards of any bridge or dwelling.

[20] *Florida:* Deer season during August open only on Friday and Saturday of each week.

[21] Ducks may be taken on Iamonia, Jackson, and Miccosukee Lakes in Leon and Jefferson Counties only on Monday, Wednesday, and Friday of each week during open season.

Bag limits and possession: One deer a day, 2 a season; 2 turkeys a day, 5 a season; 200 of any other species of game birds or animals a season; 15 cat squirrels, 15 quail, 25 doves, 15 ducks, 5 geese, 5 brant, 15 Wilson snipe, 20 coots, and 25 in all of rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, a day. Game lawfully taken may be possessed during the open season and first 5 days of close season, but not more than 2 days' limit of game may be in possession at one time.

Interstate transportation: Export of all protected game prohibited, except nonresident licensee may export game lawfully taken by himself, but not to exceed 2 deer and 5 turkeys a season nor more than two days' limit of other game during any one calendar week.

Sale: Sale of all game prohibited, except that reindeer meat may be brought into State and sold under permit from State game commissioner.

GEORGIA

Open seasons:	*Dates inclusive*
Deer	Nov. 1–Dec. 31.[22]
Bear	Nov. 20–Feb. 28.
Rabbit	Unprotected.
Cat squirrel, quail,[23] partridge, wild turkey	Nov. 20–Mar. 1.
Opossum	Oct. 1–Feb. 1.
Dove	Oct. 16–Jan. 31.
Duck, goose, brant, coot, Wilson snipe	Nov. 1–Jan. 31.
Woodcock	Dec. 1–Dec. 31.
Rail (marsh hen) and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Fawn, fox squirrel, grouse, pheasant, turkey hen, introduced game birds, swans, wood duck, eider ducks, reedbirds, bitterns, sand-hill and whooping cranes, gannet, grebes, gulls, herons, loons, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting licenses: Nonresident, $25; resident, State, $3; county, $1 (good only in county of residence). License not required of landowners or tenants and their families with consent of landowner to hunt on own land. Issued by commissioner or county warden.

Bag limits and possession: Two deer, 2 turkeys a season, 15 cat squirrels, 20 quail, 25 ducks, 8 geese, 8 brant, 20 Wilson snipe, 4 woodcock, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species; 25 doves a day. Possession of migratory birds, except woodcock, permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited; provided nonresident licensee may take out in personal possession game lawfully killed, but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be imported under a permit, fee $1, and possessed under a permit, fee $1, in like manner as game taken in State. Permits issued by game and fish commissioner.

Sale: Sale of reedbirds (ricebirds) and all protected game prohibited.

HAWAII

Open seasons:	*Dates inclusive*
Deer	Apr. 1–Oct. 31.
Quail (except bobwhite) in Maui County	Nov. 1–Jan. 31.
In Hawaii County	Dec. 1–Jan. 31.
Pheasant (male) in Maui, Kauai, and Honolulu Counties	Nov. 1–Jan. 31.
In Hawaii County	Dec. 1–Jan. 31
Wild dove, wild pigeon in Honolulu[24] County	Sept. 1–Dec. 31.
In Hawaii County	July 1–Jan. 31.
In Maui and Kauai Counties	July 1–Dec. 31.

No open season: Native wild ducks and geese, wild peacock, and blue-eyed, top-knot, bar-shouldered, green-winged, and bronze-winged doves, except as permitted by board, hen pheasant, wild African ringneck dove, chachalaca, curassow, guan, guinea fowl, bobwhite quail; quail in Kauai and Honolulu Counties.

Hunting and fishing licenses: County licenses: Nonresident citizen or declarant alien: Game, $10; fish, $2,50; resident citizen: Game, $5; fish $2.50; alien: Game, $25; fish, $5. Game licenses issued by city or county treasurer, and fishing, sampan, and boat licenses by fish and game division, Board of Agriculture and Forestry. Permission of owner or occupant required to hunt on lands of another.

Bag limits and possession: *Hawaii County:* Cock pheasants, 5 a day, 25 a season; quail, 15 a day, 30 in 7 consecutive days; doves and pigeons, 20 a day, 50 in 7 consecutive days. *Honolulu County:* Cock pheasants, 3 a day; doves and pigeons, 20 a day. *Kauai County:* Cock pheasants, 3 a day; doves and pigeons, 15 a day. *Maui County:* Cock pheasants, 5 a day, 10 in 7 consecutive days; quail, 10 a day, 25 in 7 consecutive days; doves and pigeons, 15 a day, 45 in 7 consecutive days.

IDAHO

Open seasons:[25]	*Dates inclusive*
Elk in Clearwater and Idaho Counties	Oct. 1–Nov. 15.
In Bingham, Bonneville, Clark, Fremont, Jefferson, Madison, and Teton Counties	Dec. 1–Dec. 15.
Deer, mountain goat, in Adams, Blaine, Boise, Butte, Custer, Elmore, Lemhi, and Valley Counties	Oct. 1–Oct. 31.
In Clearwater and Idaho Counties	Oct. 1–Nov. 15.
Deer in Bingham, Bonneville, Clark, Fremont, Jefferson, Madison, Teton, and Washington Counties	Oct. 1–Oct. 31.
In Benewah, Bonner, Boundary, Kootenai, Latah, Lewis, Nez Perce, and Shoshone Counties	Nov. 1–Nov. 30.
Mountain sheep (ram only—under special license) in Valley and Lemhi Counties	Oct. 15–Oct. 25.
Bear	No close season.
Chinese, ring-necked, or Mongolian pheasant, in Gooding, Jerome, Lincoln, and Twin Falls Counties	Oct. 1–Nov. 30.
In Ada, Adams, Canyon, Gem, Owyhee, Payette, and Washington Counties	Oct. 15–Nov. 30.
In Bannock, Bingham, Bonneville, Fremont, Jefferson, and Madison Counties	Nov. 1–Nov. 15.
In Cassia, Clearwater, Idaho, Latah, Lewis, Minidoka, and Nez Perce Counties	Nov. 1–Nov. 30.

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[22] *Georgia:* Killing of a deer must be reported to warden of county in which killed or to commissioner of game and fish at Atlanta within 5 days.

[23] Quail in Pierce County may be hunted only on Tuesday and Thursday of each week.

[24] *Hawaii:* Hunting prohibited in city and county of Honolulu except on Saturdays, Sundays, and legal Territorial holidays.

[25] *Idaho:* State game warden may close season in any county or part thereof on any species of game or fish threatened with extinction.

Open seasons—Continued.	*Dates inclusive*
Ruffed grouse, native pheasant, blue grouse in Blaine, Cassia, Elmore, Gooding, Jerome, Lincoln, Minidoka, Owyhee, and Twin Falls Counties	Aug. 1–Aug. 15.
In Adams, Bannock, Bear Lake, Bingham, Boise, Bonneville, Butte, Caribou, Clark, Franklin, Fremont, Gem, Jefferson, Lemhi, Madison, Oneida, Power, Teton, Valley, and Washington Counties	Aug. 15–Sept. 1.
In Clearwater, Idaho, Lewis, and Nez Perce Counties	Aug. 20–Sept. 20.
In Boundary, Bonner, Kootenai, and Shoshone Counties	Oct. 1–Oct. 30.
Sharp-tailed grouse in Adams, Cassia, Gooding, Jerome, Lincoln, Minidoka, Owyhee, Twin Falls, and Washington Counties	Aug. 1–Aug. 15.
In Bannock, Bear Lake, Caribou, Franklin, Oneida, and Power Counties	Aug. 15–Sept. 1.
Sage hen or sage grouse, in Blaine, Camas, Cassia, Elmore, Gooding, Jerome, Lincoln, Minidoka, and Twin Falls Counties	Aug. 1–Aug. 15.
In Adams, Bannock, Bear Lake, Bingham, Bonneville, Butte, Caribou, Clark, Custer, Franklin, Fremont, Jefferson, Lemhi, Madison, Oneida, Power, Teton, Valley, and Washington Counties	Aug. 15–Sept. 1.
Hungarian partridge in Benewah and Bonner Counties	Oct. 1–Oct. 15.
In Kootenai County	Oct. 1–Oct. 30.
In Clearwater, Idaho, Latah, Lewis, and Nez Perce Counties	Nov. 1–Nov. 30.
Quail in Lemhi County	Oct. 20–Oct. 31.
In Nez Perce and Twin Falls Counties	Nov. 1–Nov. 15.
Dove	Sept. 1–Dec. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot (see exception)	Oct. 1–Jan. 15.
Exception: In Boundary, Bonner, Kootenai, Benewah, and Shoshone Counties	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer, elk, mountain goat, mountain sheep (except as above); moose, antelope, caribou, buffalo, spotted fawn, calf elk; quail, grouse (except as above), imported pheasants (except Chinese, ring-necked, or Mongolian pheasants as above); prairie chickens, swans, wood duck, bitterns, little brown and sand-hill cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident:[26] Game and fish, $50; bird, $10; fish (general), $5; tourist (good for five days), $2. Alien: Game and fish, $75; fish, $10; gun license, $5. Resident: Game and fish, $2. Special licenses for mountain sheep in Valley and Lemhi Counties: Nonresident, $50; resident, $25. Issued by warden, deputy, or authorized agent. Fishing license not required of minors under 14 years of age; and veterans of Civil War may hunt and fish without a license. Persons under 12 prohibited from possessing gun afield. Taxidermist, $10.

Bag limits and possession: One deer, 1 elk, 1 goat, 1 sheep a season; 8 quail; 4 in all of Chinese, ring-necked or Mongolian pheasants; 6 in all of partridge, sage hen, native pheasant, and grouse a day or in possession; 12 ducks a day or in possession, 25 doves, 8 geese, 8 brant, 20 Wilson snipe, 25 coots, 25 sora and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Migratory waterfowl may be stored by owner, under affidavit and storage permit, during open season and 10 days thereafter. Game may not be shipped, transported, or carried more than 5 days after close of open season.

Interstate transportation: Export of all protected game prohibited, provided a hunter may export under hunting-license coupon, big game lawfully taken; and one day's limit of game birds may be transported in personal possession but may not be shipped or mailed. Big game once shipped within State may be exported under a 50-cent permit obtained from game warden or deputy. Mounted heads and stuffed birds legally obtained may be exported under a reshipping permit. Shipment of game by parcel post prohibited.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State, if identification tags or shipping or possession permits are attached.

Sale: Sale of all protected game prohibited. Hides, heads, and horns may be sold under permit.

ILLINOIS

Open seasons:[27]	*Dates inclusive*
Rabbit	Nov. 10–Jan. 31.
Squirrel, in northern zone	Sept. 1–Dec. 1.
In central zone	Aug. 1–Dec. 1.
In southern zone	July 1–Dec. 1.
Quail (bobwhite)	Nov. 10–Dec. 10.
Prairie chicken	Nov. 10–Nov. 21.
Introduced pheasant (cocks)	Nov. 10–Nov. 15.
Dove	Sept. 1–Sept. 30.
Duck (except wood duck), goose, brant, Wilson snipe, coot	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Deer (1929); wild turkey, introduced pheasant hen, sand grouse, ruffed grouse (partridge), blue, mountain, and valley quail, Hungarian partridge, capercailzie, heath hen, black grouse, woodcock (1929); swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: Game, $10.50; fish, $1.25; resident citizen: Game, $1; fish, 50 cents. Hunting licenses not issued to aliens, nor to minors under 16 without written consent of parent or guardian. Issued by village, county, or city clerk. Fishing license not required of persons under 21. Owners, their children, and tenants in actual residence may hunt during open season on own land without license. Permission required to hunt on lands of another. Taxidermist, $5.

Bag limits and possession: Ten squirrels, 15 rabbits, 12 quail, 3 prairie chickens, 2 cock pheasants, 15 doves, 15 snipe, 15 in all of coots and gallinules, 15 rails but not more than 25 in all of rails, coots, and gallinules, 15 ducks, 8 geese, 8 brant a day. Limit, in possession, 20 squirrels, 36 quail, 12 prairie chickens, 6 cock pheasants, 25 doves, 50 snipe, 60 coots and gallinules, 60 rails, 60 ducks, 10 geese, 10 brant.

Interstate transportation: Export of all protected game (except rabbit) prohibited; provided, nonresident licensee may take from State 50 game birds or animals, if carried openly for inspection, but not more than two days' limit of migratory birds may be exported in any one calendar week. Resident may carry out game under his license.

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[26] Residents of adjoining State having larger nonresident license fee for big-game hunting must pay fee charged in own State.

[27] *Illinois: Southern zone* includes Madison, Bond, Fayette, Effingham, Jasper, Crawford, and all counties south. *Central zone* includes Hancock, McDonough, Fulton, Tazewell, McLean, Ford, and all counties south to northern boundary of Southern zone. *Northern zone* includes rest of counties of State.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game (except rabbit during open season) prohibited.

INDIANA

Open seasons:	*Dates inclusive*
Rabbit	Oct. 1–Jan. 10.
Squirrel (except red squirrel, no close season)	Aug. 1–Oct. 31.
Quail, ruffed grouse	Nov. 10–Dec. 20.
Prairie chicken	Oct. 15–Oct. 31.
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Oct. 1–Jan. 15.
Woodcock	Oct. 15–Nov. 14.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer, Hungarian partridge, introduced pheasant, wild turkey, dove, swans, wood duck, bitterns, sand-hill and whooping cranes, gannet, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, fish, and trapping, $15.50; fish, $2.25. Resident: Game, fish, and trapping, $1. Issued by clerk circuit court and by superintendent and his agents. Permits to hunt and fish without license issued free to honorably discharged soldiers, sailors, and marines who are residents of the State; resident owners of farm land, their children living with them, and tenants residing thereon may hunt during open season on own land without a license. No license required of persons to fish in county of residence. All persons under 18 may fish without license. Permission required to hunt on lands of another.

Bag limits and possession: Ten rabbits, 5 squirrels (except red squirrels, no limit), 15 quail, 5 prairie chickens, 15 ducks, 6 geese, 6 brant a day; 20 Wilson snipe, 4 woodcock, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Not more than 18 woodcock and not more than three days' limit of other migratory game birds may be possessed at one time by one person. Possession of migratory game birds permitted during first 10 days of close season.

Interstate transportation: Export of deer, quail, grouse, prairie chicken, pheasant, wild turkey, and migratory game birds prohibited, except that any licensee may export 15 game birds in the aggregate of all kinds, lawfully taken by himself, each day he hunts in State, but not more than the daily limit of any one species, and not more than 2 days' limit in any one calendar week, if carried openly for inspection together with his license or the package is tagged or clearly labeled with names and addresses of shipper and consignee and an accurate statement of number and kind of birds.

Deer, turkeys, and rabbits, taken outside of State and legally exported may be possessed at any time; other game legally exported may be possessed in like manner as game taken in State.

Sale: Sale of squirrels (except red squirrels), quail, prairie chickens, introduced pheasants, Hungarian partridges, and migratory birds prohibited. Sale of rabbits prohibited during close season.

Miscellaneous: Shooting on highways or by aid of searchlight prohibited.

IOWA

Open seasons:	*Dates inclusive*
Squirrel (gray, timber, or fox)	Sept. 1–Dec. 31.
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Sept. 16–Dec. 31.
Woodcock	Oct. 15–Nov. 14.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Deer, elk, introduced pheasants,[28] Hungarian partridge, quail, prairie chicken, ruffed grouse or pheasant, wild turkey (1932); turtle dove, swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien, game, $10; fish, $3. Resident citizen, game and fish, $1. Issued by county recorder. Fishing license required of males more than 18 years of age to fish in stocked lakes. License not granted to persons under 18 without written consent of parent or guardian. Owners of farm lands, their children, and tenants or employees may hunt and fish on own lands during open season without license. Unlawful to hunt on cultivated or inclosed lands of another without permission from owner.

Bag limits and possession: Fifteen squirrels, 15 ducks, 8 geese, 8 brant, a day, 50 waterfowl in possession; 15 Wilson snipe, 4 woodcock, 15 each of rails, coots, and gallinules a day, but not more than 25 in all of rails and gallinules a day; 15 of each species in possession. Possession permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited, except that nonresident may take from State not more than 25 game birds or animals, if carried openly for inspection, and if hunting license be shown on request, but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. After expiration of first 10 days of close season in State, possessor of game must show lawful taking.

Sale: Sale of all protected game prohibited.

KANSAS

Open seasons:[29]	*Dates inclusive*
Fox squirrel	Aug. 1–Jan. 1.
Quail	Nov. 20–Nov. 30.
Prairie chicken (two days)	Oct. 22 and 23.[30]
Dove	Sept. 1–Oct. 15.
Duck, goose, brant, Wilson snipe, coot	Sept. 16–Dec. 31.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Deer, antelope, red, gray, and black squirrels, ruffed grouse (partridge), pheasant (English, Mongolian, Hungarian); woodcock; swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, terns, upland plover, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15; fish, $3. Hunting license issued by secretary of state and fishing license by county clerks. Resident: Game, $1; fish, $1. Issued by county clerk. Resident landowner or member of family may hunt or fish on own premises during open season without a license. Fishing license not required of males under 18, nor of women. Unlawful to hunt on land of another or on highway or railroad right of way adjacent thereto without consent of owner, unless accompanied by him.

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[28] *Iowa:* Upon petition of 150 farmers and landowners in any county who have suffered damage by Chinese, Mongolian, English, or ring-necked pheasants, State game warden may fix an open season for such county, during which a person may kill not exceeding 12 such pheasants a day or capture them alive without limitation as to number. The warden may pay $1 each for pheasants delivered alive to him.

[29] *Kansas*: Seasons and bag limits may be shortened or reduced when deemed advisable by forestry, fish, and game commission.

[30] Season on prairie chicken fixed by the commission.

Bag limits[30] **and possession:** Quail, 10 a day, 25 a season, 5 prairie chickens a day, 10 a season; 15 in all of ducks, coots, and gallinules; 20 doves, 5 in all of geese and brant, 6 rails, and 15 Wilson snipe a day. Possession permitted during first five days of close season.

Interstate transportation: Export of all protected game birds prohibited, except that a person under hunting license and affidavit of lawful killing and possession may ship to himself not more than two days' limit of two kinds of game taken by himself.

Game of not more than two kinds, and not more than two days' bag limit, taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. After expiration of first five days of close season in State, possessor of game must show lawful taking.

Sale: Sale of all protected game prohibited.

KENTUCKY

Open seasons:	*Dates inclusive*
Rabbit[31]	Nov. 15–Dec. 31.
Squirrel	July 1–Dec. 15.
Quail, ruffed grouse (native pheasant)	Nov. 15–Jan. 1.
Introduced pheasant (male)	Nov. 15–Nov. 19.
Dove	Sept. 1–Dec. 15.
Woodcock	Nov. 15–Dec. 15.
Duck, goose, brant	Nov. 1–Jan. 31.
Wilson snipe or jacksnipe, coot	Nov. 1–Dec. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer, elk (1932); introduced pheasant hen, Hungarian partridge, wild turkey (1932); swans, wood duck, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, jaegers, loons, petrels, terns, and all shore birds (except woodcock and Wilson snipe).

Hunting licenses: Nonresident or alien, $10.50. Resident, $1. Issued by county clerk. Resident landowner, tenant, and members of families may hunt on own land during open season without license. Unlawful to enter inclosed lands of another for shooting, hunting, or fishing without consent.

Bag limits and possession: Twelve squirrels a day, 24 in possession at one time; 12 quail a day, 12 in possession for each successive day of hunt; 2 cock pheasants a day; 15 doves a day, 15 in possession for each successive day of hunt; 2 ruffed grouse a day; 25 ducks, 8 geese, 8 brant, 4 woodcock, 20 Wilson snipe, and 25 in all of rails, coots, and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day.

Interstate transportation: Export of deer, elk, and all game birds prohibited, except that a hunter may transport game lawfully killed and possessed by him, but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed during open season in State in like manner as game taken in State.

Sale: Sale of quail, partridge, grouse, introduced or native pheasant, Hungarian partridge, wild turkey, and migratory birds, wherever killed, prohibited.

LOUISIANA

Open seasons:[32]	*Dates inclusive*
Deer in Concordia, Avoyelles, Rapides, Vernon, and all parishes north thereof	Dec. 1–Jan. 15.
In parishes south	Nov. 1–Jan. 5.
Bear	Oct. 15–Jan. 5.
Squirrel, chipmunk	Oct. 1–Jan. 15.
Hare, rabbit	Oct. 1–Feb. 18.
Quail	Dec. 1–Feb. 15.
Wild turkey	Mar. 5–Apr. 5.
Woodcock	Dec. 1–Dec. 31.
Dove	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Duck, goose, brant, Wilson snipe, rail, coot, gallinule	Nov. 1–Jan. 31.

No open season: Fawns, elk, prairie chicken, introduced pheasant, swans, wood duck, bobolink, bittern, sand-hill and whooping cranes, gannet, grebes, gulls, herons, loons, petrels, terns, upland plover (papabotte) and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting licenses: Nonresident: Game animals and resident game birds, $50; migratory game birds, $25. Resident, $1. Club or association, $5. Alien: General, $50; game birds, $25. Issued by tax collectors. License does not authorize hunting on land of another without his written consent.

Bag limits and possession: Deer, bear, 1 each a day, 5 each a season; squirrels and chipmunks combined, 10 a day, 120 a season; 1 turkey a day, 5 a season; quail, 15 a day, 120 a season; dove, 25 a day, 300 a season; ducks, 25 a day, 300 a season; geese and brant combined, 8 a day, 100 a season; Wilson snipe, 20 a day, 240 a season; coots, 25 a day, 300 a season; sora, 25 a day, 300 a season; rails and gallinules combined, 25 a day but not more than 15 of any one species of rails (other than sora) and gallinules a day, 300 a season; woodcock, 4 a day, 22 a season.

The daily bag limits include all birds taken by guide or other person who for hire accompanies or assists a hunter in taking them. Game in excess of one day's limit in possession must be tagged. Possession of game birds permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited; provided a nonresident licensee may carry with him out of the State under his license and tag two days' limit of game birds, if not for sale. All game and all packages containing game must be tagged to show kind and number, names of consignor and consignee, initial point of billing, and destination.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all game (except hares and rabbits during open season and 10 days thereafter) prohibited.

MAINE[33]

Open seasons:[34]	*Dates inclusive*
Deer (see exceptions)	Oct. 16–Nov. 30.
Exceptions: In Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, and York Counties	Nov. 1–Nov. 30.
In Hancock and Washington Counties	Nov. 1–Dec. 15.
Hare, rabbit (see exception)	Oct. 1–Mar. 31.
Exception: In Androscoggin, Sagadahoc, and York Counties	Oct. 1–Feb. 28.
Gray squirrel	Oct. 1–Oct. 31.[35]
Ruffed grouse, partridge	Oct. 1–Nov. 30.

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[30] *Kansas:* Seasons and bag limits may be shortened or reduced when deemed advisable by forestry, fish, and game commission.

[31] *Kentucky:* Rabbits may be taken with dogs or traps (except snares) at any time for a person's own use on his own land, but not for sale or barter.

[32] *Louisiana:* Seasons on game may be curtailed in any parish by police juries with consent of commissioner.

[33] *Maine:* Commissioner may make local regulations and governor may suspend hunting or fishing seasons during drought.

[34] All hunting is prohibited on Kineo Point and Mount Katahdin, Piscataquis County; on Prouts Neck, on Richmond Island, and locally on Cape Elizabeth and in town of Scarboro, Cumberland County; southern point Swan Island; Bartlett Island, Hancock County. (See State laws for details and other protected areas.)

[35] Squirrels protected in parks and in compact or built-up portions of cities and villages.

Open seasons—Continued.	*Dates inclusive*
Woodcock	Oct. 1–Oct. 31.
Duck, goose, brant, Wilson snipe, coot (see exception)	Sept. 16–Dec. 31.
Exception: Waterfowl, in Back Bay, Portland, above Grand Trunk Railway bridge	No open season.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Moose (1929); deer on Cross, Scotch, Swan, and Mount Desert Islands, and in towns of Deer Isle and Stonington, in Hancock County, in Isle au Haut, in Knox County, in Perkins, Sagadahoc County, Kineo Point and Katahdin Park Game Preserve, Piscataquis County, Ganeston Park and Augusta Game Preserve, Kennebec County, Rangeley Game Preserve, Franklin and Oxford Counties, Lincoln County Game Preserve, and in all places where hunting is prohibited by law; cow and calf moose, caribou, Hungarian partridge, pheasant, black game, capercailzie, cock of the woods, dove, swans, wood duck, eider ducks, auks, bitterns, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident hunting licenses: Deer or other game (except caribou and moose), Oct. 16–Dec. 31, $15; birds, prior to Oct. 16 in Aroostook, Franklin, Hancock, Oxford, Penobscot, Piscataquis, Somerset, and Washington Counties, $5; season (except November) in rest of State (8 southern counties), $5. For November (in southern counties), a $15 license is required. Holder of a license may exchange it for a license for which a larger fee is required by paying difference in cost. Nonresident must be accompanied by registered guide when hunting or when camping and kindling fires while fishing on wild lands (land in unorganized or unincorporated townships), May 1 to Nov. 30, except nonresident fishermen do not require guide in wild lands if camping on official site provided by Maine forest service and building fires only in fireplace provided on such site. Nonresident fishing license, $3.15 (not required of children under 14 years of age); nonresident, ice fishing, $2.15; resident alien fishing license, $2.15. Resident alien, game, $15 (not required of aliens who pay taxes on real estate and who have resided in State two years continuously prior to application). Taxidermist: Resident citizen, $5; resident alien, $25. Guide licenses: Nonresident, $20 (issued only to residents of adjoining States or Provinces); resident, $1. Must not guide more than five nonresidents hunting at one time. Sporting camp, $5. Shipping licenses (within State): Resident, deer, $2; one pair of game birds in seven days, 50 cents. Issued by commissioner.

Resident hunting and fishing license, fee 25 cents. Resident or member of immediate family may hunt without a license during open season on own land used exclusively for agricultural purposes and on which he is actually domiciled. License valid as long as holder remains a resident of State. Issued by city, town, and plantation clerks.

Bag limits and possession: One deer a season; 5 ruffed grouse a day, or in possession 25 a season; 10 ducks, 8 geese, 8 brant, 10 Wilson snipe, 4 woodcock a day or in possession, 25 coots, 25 sora, 25 in all of other rails, and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Transportation of migratory game birds must be completed within five days after close of season; reasonable time allowed after close of season to transport other game to home of owner. Deer may not be used or had in possession in lumber camps. Possession of migratory birds limited to first 10 days of close season; deer legally procured may be possessed during close season.

Interstate transportation: Export of all protected game prohibited; provided, a resident of the State, under shipping license (fee, $5) may export 5 partridges, 4 woodcock, or 10 ducks, lawfully killed by himself, but he must accompany the birds. A nonresident may export, open to view under hunting-license tag, 1 deer, 5 partridges, 10 ducks, 4 woodcock and rabbits or hares, lawfully killed by himself, upon identifying same at shipping point; nonresident licensee may also ship out 1 pair of game birds a month under a special 50-cent license.

Moose or caribou, or parts thereof, taken outside of State and legally exported may be imported under permit and shipping tag and possessed at any time. Deer properly tagged where taken and game birds may be imported under permit during open season in State and possessed in like manner as game killed in State, but the importer of a deer may not kill one in State during same season. Permits and shipping tags issued by commissioner of inland fisheries and game.

Sale: Sale of all protected game birds prohibited; unlawful to sell, give away, or accept deer for export. Local provision dealer, under $5 license, may purchase 2 deer for retail to his local customers. Deer skins and skins with heads attached may be bought and sold by residents under $25 license. Heads, when detached from skins with which purchased, may be sold to licensed taxidermists.

Miscellaneous: Unlawful to possess rifle or shotgun, either loaded or with a cartridge in magazine thereof, in or on any motor vehicles while upon any highway or in fields or forests.

MARYLAND

Open seasons:	*Dates inclusive*
Deer (male having four or more points to one antler) in Allegany County and within a game reserve inclosed with 7-foot fence in Washington County	Dec. 1–Dec. 15.
Rabbit or hare, quail (partridge), ruffed grouse (pheasant), English or Mongolian pheasant, wild turkey (see exception)	Nov. 10–Dec. 31.
Exception: Wild turkey in Garrett County (1930).	
Squirrel (see exception)	Sept. 1–Sept. 30. Nov. 10–Dec. 31.
Exception: In Allegany, Baltimore, Garrett, Howard, and Washington Counties	Nov. 10–Dec. 31.
Woodcock	Nov. 10–Dec. 10.
Dove (see exception)	Sept. 1–Sept. 30. Nov. 10–Dec. 15.
Exception: In Allegany, Baltimore, Garrett, Howard, and Washington Counties	Nov. 10–Dec. 15.
Duck, goose, brant, Wilson snipe, coot	Nov. 1–Jan. 31.[36]
Rail and gallinules other than coot	Sept. 1–Nov. 30.

No open season: Deer (except as above), elk (1931); Hungarian partridge, reedbirds, swans, wood duck, eider ducks, auks, bitterns, sand-hill crane, gannet, grebes, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15.50 (fee, $5.50 for State license if applicant owns real estate in Maryland assessed at $500; $1.50 for county license in county where such real estate is located); fish, $5. Resident: Game, State, $5.25; county, $1.25; fish, $1. Special license for fishing in Deep Creek Lake, Garrett County: Resident of county, $1.25; resident of State, nonresident of county, $2.75; nonresident of State, $5.25. Issued by clerks of circuit court of counties—in Baltimore City by clerk, court of common pleas. Permanent resident of Indianhead

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[36] Footnote on page 21.

Government reservation may obtain a resident hunting license for Charles County. Hunting license not issued to persons under 14 years of age without written request of parent or guardian. Angling license required above tidewater of person over 18 years of age. License not required of landowners, tenants, and members of their families fishing from shore of own property. Licensee required to wear tag displayed on middle of back. Owners, tenants, and their children may hunt on own land during open season without license, except that waterfowl may not be hunted on waters of the State without license. Local licenses issued to residents of Cecil and Harford Counties are valid for waterfowl hunting on Susquehanna Flats.

Sinkbox, sneak boat, blind, pusher: Sinkbox, $20.50; sneak boat, $5.50; issued by clerks circuit court of county of which applicant is a resident; booby, brush, or stake blind, $5.50 (not issued except to resident of State or nonresident owner of land bordering on Potomac River or nonresident owner of land bordering on any waters of the State that is assessed at $500 on tax books of Maryland); pusher, $2.50; issued by clerks circuit court of counties.

Susquehanna Flats: [36] Sinkbox, $20.75; sneak boat, $5.75; issued by clerks, circuit court in Cecil and Harford Counties.

Bag limits and possession: One deer a season; 1 wild turkey a day, 4 a season; 2 in all of English or Mongolian pheasants and ruffed grouse a day, 6 a season; 6 rabbits or hares, 10 squirrels, 10 quail (partridge), 4 woodcock, 25 doves, 20 jacksnipe, 25 coots, 25 in all of rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, 25 ducks, 8 geese, 8 brant a day. Possession of waterfowl permitted during first 10 days of close season.

Interstate transportation: Export of all protected game (except waterfowl) prohibited; provided, a licensed hunter may take out under his license as personal baggage a quantity equal to 2 days' bag limit of game; provided further, no person may take or ship out more than 50 ducks, 16 geese, and 16 brant in any one calendar week. Waterfowl must be shipped open to view and tagged.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of quail, ruffed grouse, wild turkey, or introduced pheasant (whether taken within or coming from without State), and doves and all other migratory game birds prohibited.

MASSACHUSETTS

Open seasons: [37]	*Dates inclusive*
Deer (from sunrise, first Monday in December to sunset the second following Saturday, inclusive)	Dec. 3–Dec. 15.
Hare (known as varying or Canada hare or snowshoe or white rabbit) or rabbit (see exceptions)	Oct. 20–Feb. 15.
Exceptions: In Nantucket County	Oct. 20–Feb. 28.
In Dukes County	Nov. 15–Feb. 15.
European hares in Berkshire County	No close season.
Open seasons—Continued.	*Dates inclusive*
Gray squirrel, quail, pheasant (male),[38] (see exceptions)	Oct. 20–Nov. 20.
Exceptions: Quail in Essex, Hampden, Hampshire, Middlesex, Nantucket, Norfolk, and Worcester Counties	No open season.
Pheasant in Dukes and Nantucket Counties	No open season.
Woodcock	Oct. 20–Nov. 19.
Duck, goose, brant, Wilson snipe, coot (see exceptions)	Sept. 16–Dec. 31.
Exceptions: In Dukes and Nantucket Counties, and south and east of Cape Cod Canal in Barnstable County	Oct. 1–Jan. 15.
Rail and gallinule, other than coot	Sept. 16–Dec. 15.

No open season: Moose, dove, ruffed grouse, prairie chicken, Hungarian partridge, pheasants (English, golden, Mongolian),[38] heath hens, swans, wood duck, eider ducks, auks, bitterns, sand-hill and whooping cranes, fulmars, gannet, guillemots, gulls, herons, jaegers, loons, murres, terns, and all shore birds (except woodcock, and Wilson snipe or jacksnipe).

Hunting and fishing [39] licenses: (Sporting licenses): Nonresident citizen, $5.25. Nonresident, residing in a State affording similar privileges to residents of Massachusetts, who owns real estate assessed at not less than $500, or who is a member of a hunting or fishing club or association incorporated prior to 1907, or who is a guest on written invitation of an incorporated club or association for hunting foxes, fee, $2.25.

Resident citizen, $2.25. Alien, $15.25 (applicant must have resided in State 10 days and own real estate therein to the assessed value of $500). Duplicate of lost or destroyed license, fee, 50 cents. Issued by city and township clerks.

Sporting licenses not issued to minors under 15, and those under 18 must apply in writing and furnish written consent of parent or guardian. A license (fee, 75 cents) to trap quadrupeds may be issued to a minor between the ages of 12 and 18.

Resident may hunt during open season without a license on land owned or leased on which he is actually domiciled and which is used exclusively for agricultural purposes, and not for club, shooting, or fishing purposes, and may fish in inland waters bordering such lands. License to fish not required of minors under 18.

Bag limits and possession: One deer a season; 2 hares and 5 rabbits a day or in possession; 5 gray squirrels a day, 15 a season; 4 quail a day, 20 a season; 2 pheasants a day, 6 a season; 4 woodcock a day, 20 a season; 25 ducks (but not more than 15 black ducks), 8 geese, 8 brant, 20 Wilson snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules; but not more than 15 of any one species of rails (other than sora) and gallinules a day. Resident may possess a deer during first 30 days and other game during first 10 days of closed season if legally taken or acquired by him, and for his personal use only and not for sale; game legally taken and exported from another State or country may be imported and possessed for 10 days after arrival.

Interstate transportation: Export of quail, woodcock, and ruffed grouse taken in State prohibited; provided, a nonresident under his license may take 10 birds into another State according similar privileges, if carried open to view and the commission or district deputy is notified; provided further, a resident may export all game (except quail, ruffed grouse, woodcock), but not more than two days' bag limit of migratory birds may be exported in any one calendar week. No game illegally taken may be exported.

Game taken outside of State and legally exported may be possessed for personal use: Deer for 30 days and other game for 10 days immediately succeeding arrival in State.

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[36] *Maryland:* Wild-fowl shooting restricted locally as follows: On the Susquehanna Flats south of a line from Concord Lighthouse, Harford County, and Carpenters Point, Cecil County, and north of a line extending from Turkey Point Lighthouse, Cecil County, and half a mile north of Spesutie Island to Oakington, Harford County, but at no time approaching within one-half mile of northern end of Spesutie Island or adjacent mainland, hunting allowed only on Mondays, Wednesdays, and Fridays, Nov. 1–Dec. 31, and Mondays, Wednesdays, Fridays, and Saturdays, Jan. 1–31; in Kent County, on Chester River and tributaries, on Mondays and Fridays only, Nov. 1 to Dec. 31, but not restricted during January except by general provision prohibiting all hunting on Sunday.

[37] *Massachusetts:* Governor may suspend open seasons during extreme drought.

[38] Commission may open season on pheasants.

[39] License required to fish in inland waters that have been stocked with fish by commission since Jan. 1, 1910.

Sale: Sale of all game prohibited; provided, deer, moose, caribou, and elk lawfully killed and coming from without State, under warden's tag, may be sold under license at any time. Hares or rabbits lawfully obtained and coming from a State where their sale is not prohibited may be sold during the open season.

Miscellaneous: Deer may be taken with a shotgun only. Unlawful to hunt or kill game with rifle or revolver during open season for deer, or to have dog in woods, except in Dukes and Nantucket Counties.

MICHIGAN

Open seasons: [40]	*Dates inclusive*
Deer (male, with horns not less than 3 inches above the skull), bear	Nov. 15–Nov. 30.
Rabbit, hare (see exceptions)	Oct. 25–Jan. 31.
Exceptions: Snowshoe or jack rabbit, Lower Peninsula	Oct. 25–Feb. 15.
Rabbit, Upper Peninsula	Oct. 1–Feb. 1.
Fox squirrel, male Chinese or ring-necked pheasants, woodcock	Oct. 25–Oct. 31.
Duck, goose, brant, Wilson snipe, coot	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Elk, moose, caribou, dove, quail, ruffed grouse or partridge, prairie chicken, squirrel (black or gray), Canada or spruce grouse, hen pheasants, wild turkey, swans, wood duck, eider ducks, auks, bitterns, sandhill and whooping cranes, gannet, grebes, gulls, herons, jaegers, loons, murres, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Deer, $50; small game, $10; fish, general, $5; special (fish, except brook trout and bass), $2 (fishing license not required of persons under 18 years of age). Resident: Deer, $2.50; small game, $1.25; trout, $1. Issued by county clerks, director, or deputy. Hunting licenses issued to persons under 17 and over 12 on application of parent or guardian, who must accompany such minors when hunting. Residents and minor children may hunt without a license during open season small game on own inclosed land on which they reside. Unlawful to hunt on posted farmlands without consent of owner or person in possession.

Bag limits and possession: One deer a season; 5 fox squirrels a day, 15 a season; 5 rabbits a day, 10 in possession; 5 ruffed grouse or prairie chickens a day, 10 each in possession, 20 ruffed grouse, 25 prairie chickens a season; 2 Chinese or ring-necked pheasants a day, 4 a season; 15 ducks a day, 30 in possession, 50 a calendar week; 5 geese and brant a day, 8 in possession, 15 a season; 4 woodcock a day, 10 in possession, 20 a season; 15 Wilson snipe a day, 20 a season; 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Game birds lawfully killed may be possessed during first 10 days of close season, except partridge, during first 5 days, and game animals during first 30 days thereof. Camping party of 6 or not less than 4 licensed hunters, maintaining a camp of not less than 4 persons for not less than seven days may, under permit (fee, $3), kill 1 deer for camp purposes.

Interstate transportation: Export prohibited of all protected game. *Exceptions:* (1) Deer may be transported outside State to reach a point within State. (2) Nonresident licensee may take out as hand baggage, open to view, one day's bag limit of birds, and may ship one deer lawfully killed by himself when license tag and seal are attached. (3) Deer skins and green or mounted buck-deer heads may be exported under permit.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game; provided, deer skins and green or mounted buck-deer heads lawfully taken may be sold or transported under permit.

MINNESOTA

Open seasons: [41]	*Dates inclusive*
Deer (season closed in odd, open in even years)	Nov. 10–Nov. 20.
Bear, varying hare or snowshoe rabbit	No close season.
Squirrel (gray or fox)	Oct. 15–Jan. 1.[42]
Quail	Oct. 15–Nov. 20.
Male ring-necked pheasant (season closed in odd, open in even years)	Oct. 15–Nov. 1.
Prairie chicken or pinnated grouse, white-breasted or sharp-tailed grouse (season closed in even, open in odd years)	Sept. 16, 1929.
Mourning dove	Sept. 16–Oct. 1.
Duck (except wood duck), goose, brant, coot, Wilson snipe or jacksnipe	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Elk, moose, caribou, black squirrel; ruffed grouse (1929); Canada spruce grouse, ring-necked pheasant hens, Hungarian gray partridge, wild turkey, upland plover, woodcock, black-bellied and golden plovers, swans, wood duck, eider ducks, auks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Big game, $50.25 (includes metal-locking deer seal); small game, $25. Issued by commissioner. Fishing license, $3 (not required of persons under 16 years of age if parent or guardian is licensed). Issued by commissioner, county auditors, game wardens, and agents. Resident: Big-game animals, $2.25 (includes metal-locking deer seal); small game, $1; fish, 50 cents (family license to fish, $1—includes identification card for each member of family 21 years of age or over); fishing license not required of resident under 21; fish house, $1. Issued by county auditor. Hunting license not required of persons under 16 and owners, lessees, or members of their immediate families may hunt birds or animals (except deer) during open season on own or leased land occupied by them as permanent residence without license.

Licensee, within 30 days after expiration of license, must report to State game commissioner the number of each kind of game killed. Unlawful to enter growing grainfields for purpose of hunting without permission of owner.

Bag limits and possession: One deer a season; 10 squirrels a day, 15 in possession; 5 geese, 12 ducks, and 15 in all of coots, gallinules, Wilson snipe or jacksnipe, and rails a day, 36 in all in possession, of which not more than 5 may be geese, 120 ducks a season; 10 quail a day, 15 in possession, 30 a season; mourning dove, 9 a day, 30 in possession, 30 a season; 3 ring-necked pheasants a day, 12 in possession, 15 a season, but not more than 15 game birds in all in one day. Possession permitted during first 5 days of close season. Under permit or tags deer may be possessed to February 28, migratory birds for 10 days after close of season, but no game birds may be possessed after January 10.

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[40] *Michigan:* The director upon approval of the conservation commission may shorten or close the season and otherwise restrict the taking of any species of game (except that he may not modify open seasons on waterfowl as fixed by Federal or State law) for a period of not to exceed five years, in any county. Such orders may be modified or rescinded when conditions warrant.

[41] *Minnesota:* Seasons subject to change by regulations. All hunting prohibited within 3 miles of corporate limits of Duluth, Minneapolis, and St. Paul.

[42] Squirrels protected within corporate limits of any city or village, or within a quarter of a mile thereof.

Interstate transportation: Export of all protected game prohibited, except that nonresident licensee may ship home in open season under his license coupons 1 deer and 25 birds lawfully taken by himself, but not more than 16 geese may be exported in any one calendar week. Deer hides for tanning and heads for mounting may be exported when tagged with license coupons (deer season closed in odd years).

Game taken outside of State and legally exported may be possessed at any time under a retaining tag, obtained from State game and fish commissioner, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited; provided, hides of deer legally killed may be sold.

Miscellaneous: Unlawful to carry gun in motor vehicle unless unloaded in both barrel and magazine and taken apart or contained in a case.

Unlawful to keep game in cold storage.

MISSISSIPPI[43]

Open seasons:	*Dates inclusive*
Deer (male)	Nov. 15–Feb. 15.
Bear	Nov. 1–Feb. 28.
Squirrel (also May 1–June 1)	Oct. 1–Dec. 15.
Hare, rabbit	No close season.
Quail or partridge (bobwhite)	Nov. 20–Jan. 15.
Wild-turkey gobblers	Jan. 1–Mar. 31.
Dove	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Woodcock	Dec. 1–Dec. 31.
Waterfowl, Wilson snipe or jacksnipe, coot, poule d'eau	Nov. 1–Jan. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Does and spotted fawns; turkey hens, ruffed grouse, pheasant, western quail, swans, wood duck, bitterns, sand-hill crane, grebes, gulls, herons, loons, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, State, $15; county, $10; fish, $2 (county). Resident: Game, State, $3; county, $1 to $3 in discretion of board of supervisors. Issued by sheriff. License not required for hunting rabbits, nor of persons under 16 or over 70 years of age. Landowners may hunt during open season on own lands without license. Written permission of owner or agent required to hunt, trap, or fish on posted lands of another.

Bag limits and possession: One deer a day, 3 a season; 1 bear a season; 15 squirrels a day; 2 turkey gobblers a season; 15 quail a day; 25 ducks, 8 geese, 8 brant, 20 Wilson snipe, 4 woodcock, 25 doves, 25 coots, 25 sora, but not more than 25 in all of rails (other than sora), coots, and gallinules, and not more than 15 of any one species of rails (other than sora) and gallinules a day. Nonresidents limited to not more than 25 migratory game birds of all kinds in one day. Possession of migratory birds permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited, except that a nonresident licensee may take out in personal possession one day's limit of game birds he has lawfully killed.

Game taken outside of State and legally exported may be possessed only during open season in State, but migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game (except rabbits) prohibited.

MISSOURI

Open seasons:	*Dates inclusive*
Wild turkey	Dec. 1–Dec. 31.
Squirrel	July 1–Nov. 30.
Quail (bobwhite partridge)	Nov. 10–Dec. 31.
Dove	Sept. 1–Dec. 15.
Duck, goose, brant, Wilson snipe, coot	Sept. 16–Dec. 31.
Woodcock	Nov. 10–Dec. 10.
Rail and gallinule, other than coot	Sept. 15–Nov. 30.

No open season: Deer (1930), ruffed grouse (pheasant), prairie chicken (pinnated grouse), imported pheasants, other introduced game birds, swans, wood duck, bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Game and fish, $10; fish, $3. Issued by commissioner or county clerk. Resident: Game and fish: State, $2.50; county, $1, good in county of residence or adjoining county; fish (State), $1. Issued by county clerk or license collector. Fishing license not required in county of residence nor of women or minors who are citizens. Owners and tenants of agricultural lands and members of family under 21 residing thereon may hunt without license during open season on own or leased land when used for agricultural purposes only, but may not transport or ship game or fur animals therefrom without a license. Hunting on land of another prohibited without his consent.

Bag limits and possession: Four turkeys a season; 1 turkey, 10 quail, 10 doves, 15 ducks, 8 geese, 8 brant, 4 woodcock, 15 Wilson snipe a day; 15 rails, 15 coots, 15 gallinules, but not more than 25 in all a day or in possession; or 2 turkeys, 15 quail, 15 doves, 25 of any other species of birds in possession. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof.

State hunting license required to possess game.

Interstate transportation: Export of all protected game prohibited, except that not more than two days' limit of game may be exported under resident or nonresident license if carried openly as baggage or express or in owner's possession and accompanied by him.

Game taken outside of State and legally exported may be possessed in like numbers and manner as game taken in State, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited.

MONTANA

Open seasons:[44]	*Dates inclusive*
Deer (male with horns 4 inches above the skull) (see exceptions)	Oct. 15–Nov. 15.
Exceptions: Deer, either sex, in Beaverhead, Flathead, Glacier, Lake, Lincoln, Madison, Mineral, and Sanders Counties and in part of Ravalli County	Oct. 15–Nov. 15.
Deer, either sex, in part of Ravalli County	Sept. 20–Oct. 20.
In Carbon, Carter, Custer, Dawson, Garfield, Musselshell, McCone, Phillips, Powder River, Prairie, Richland, Roosevelt, Rosebud, Teton, Treasure, Valley, Yellowstone, and parts of Fergus, Gallatin, Glacier, and Pondera Counties	No open season.

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[43] *Mississippi:* Board of supervisors of any county may by regulation shorten or close seasons, reduce bag limits, or extend other protection to game within the provisions of the law.

[44] *Montana:* Commission may close season in any district on any species of game threatened with undue depletion from any cause, or reopen such districts, may advance the date of open season on sage grouse in any county, and may specify open seasons and bag limits, locally, on upland game birds on which season is closed.

Open seasons[44]—Continued.	*Dates inclusive*
Elk in Flathead, Glacier, Madison, Pondera, Teton, and parts of Gallatin, Lewis and Clark, Missoula, and Powell Counties	Oct. 15–Nov. 15.
In Granite County and in part of Powell County	Nov. 10–Nov. 12.
In Jefferson County (bull only)	Nov. 12–Nov. 14.
In part of Lewis and Clark County	Nov. 1–Nov. 15.
In Park County	Oct. 15–Dec. 20.[45]
In part of Ravalli County	Sept. 20–Oct. 20.[45]
Bear (unlawful to trap)	No close season.
Pheasant, partridge, prairie chicken, fool hen, sage hen, grouse	Sept. 16–Sept. 25.
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Mountain sheep, mountain goat (except as opened locally by commission); elk (except as above), does and fawns, moose, caribou, antelope, bison, or buffalo; quail, introduced pheasant, Hungarian partridge, ptarmigan, wild turkey [44]; dove, swans, wood duck, bittern, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: General, $30; game birds and fish, $10; fish, $3.50. Alien: General, $50; fish, $10. Resident citizen,[46] $2. Guide (resident citizen), $10. Shipping (export), 50 cents. Taxidermist, $15. Issued by warden or deputy.

No license required of minors under 15. Alien not holding hunting license required to obtain from warden $25 license to possess firearms.

Bag limits and possession: One buck (1 deer of any age or either sex in Beaverhead, Flathead, Glacier, Lake, Lincoln, Madison, Mineral, Ravalli, and Sanders Counties), 1 elk a season; 5 in all of grouse, partridge, prairie chickens, fool hens, pheasants, and sage hens, a day or in possession; 25 ducks, 8 geese, 8 brant, 20 Wilson snipe, 25 coots, 25 sora, 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Migratory game birds legally taken may be possessed during open season and first 10 days of close season.

Interstate transportation: Export of all protected game prohibited; provided, game lawfully killed may be exported by a resident under shipping permit (fee, 50 cents) from State warden; a nonresident may export under his license game he has lawfully taken; total shipments under permits or one license may not exceed season's bag limit and not more than two days' limit of migratory birds may be exported in any one calendar week; packages must be labeled to show contents.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of bears and all protected game prohibited; provided, merchant or hotel or restaurant keeper may sell game, except migratory birds, killed outside the State. Under permit, mounted specimens or hides or heads of game animals or birds lawfully taken may be sold.

NEBRASKA

Open seasons:	*Dates inclusive*
Squirrel (gray, red, fox, timber)	Sept. 16–Dec. 31.
Prairie chicken, grouse	Oct. 1–Nov. 1.
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Deer, elk, antelope, mountain sheep, quail, partridge, sage hen, introduced pheasant [47] or partridge, ptarmigan, introduced game birds, dove, wild turkey, woodcock, swans, wood duck, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: General, $25.10; fish, $2.10. Alien: Fish, $5.10. Resident, $1.10. Issued by State department of agriculture and authorized vendors. Licenses required of all persons over 16 years of age. Consent of owner required to hunt on private premises. Alien not permitted to hunt or to own or possess firearms.

Bag limits and possession: Ten squirrels a day, 20 in possession; 5 prairie chickens or grouse a day, or in possession; 20 ducks a day, 40 in possession; 5 geese, 5 brant a day or in possession; 15 Wilson snipe a day, 25 in possession; 20 coots and gallinules, but not more than 15 gallinules a day, 40 in possession; 15 rails, but not more than 25 rails and gallinules a day, 25 rails in possession, 50 in all of game birds in possession. Possession permitted during first 10 days of close season.

Interstate transportation: Game may be transported by express or baggage during the open season if shipment is accompanied by shipper's affidavit that the game is not for sale or profit and was not taken contrary to law; package must be labeled with consignor's license number and kind of game, consigned to shipper, and accompanied by him; shipment must not contain more than 50 game birds or the possession bag limit on any species. Not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited.

NEVADA

Open seasons:[48]	*Dates inclusive*
Deer (male with branched horns)	Oct. 16–Oct. 31.[48]
Bear	Nov. 15–Mar. 15.
Cottontail rabbit, mountain hare	Nov. 1–Dec. 31.
Grouse, mountain quail	Sept. 24–Sept. 30.
Sage hen or sage cock, prairie chicken	Aug. 1–Aug. 16.
Dove	Sept. 1–Dec. 15.
Duck, goose, brant, coot, Wilson snipe or jacksnipe	Sept. 16–Dec. 31.[49]
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

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[44] See page 23 for footnote.

[45] Commission may on five days' notice close season on elk in Park County, and may shorten the season in Ravalli County.

[46] Resident licenses issued to officers of the Forest Service and of the Bureau of Biological Survey, members of United States Department of Agriculture, and to officers and members of the United States Army, Navy, or Marine Corps.

[47] *Nebraska:* State department of agriculture may open season and fix bag limits on male Chinese, ring-necked, or English pheasant on application of county board.

[48] *Nevada:* County commissioners may fix open seasons on pheasants and valley quail and shorten open seasons on other game upon petition of 50 or more resident electors of county; and may designate open season of 16 days on buck deer with branched horns between Oct. 1 and Oct. 31, instead of Oct. 16 to Oct. 31, or close season entirely.

[49] Ducks, geese, and brant may be hunted only on Wednesday, Saturday, and Sunday of each week during the open season, and in addition on Oct. 12 and 31, Nov. 11, Thanksgiving and Christmas Days, and Dec. 31.

No open season: Elk, mountain sheep, mountain goat, antelope (1930); does, fawns, and spike bucks; quail (except mountain quail) and pheasant;[48] swans, wood duck, bitterns, little brown and sand-hill cranes, grebes, gulls, herons, loons, murres, band-tailed pigeons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen:[50] Game, $10; fish, $3. Alien: Fish, $7.50. Resident citizen: Game, $1.50; fish, $1.50. Hunting and fishing licenses issued free of charge to resident Indians. Issued by county clerks and wardens. Aliens prohibited from hunting. No license required of boys or girls under 14.

Bag limits and possession: One deer a season; 5 cottontail rabbits, 2 mountain hares, 10 valley quail, 5 mountain quail, 3 partridges, 3 grouse, 3 pheasants, 5 prairie chickens, 10 sage hens, 15 ducks, 5 geese, 5 brant, 10 snipe, and 25 doves a day or in possession; 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession of migratory birds permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of deer meat and of all other protected game prohibited.

NEW HAMPSHIRE

Open seasons: [51]	*Dates inclusive*
Deer in Coos County	Oct. 15–Nov. 30.
In Carroll County	Nov. 15–Dec. 15.
In Cheshire County	Dec. 1–Dec. 15.
In Grafton County	Nov. 1–Dec. 15.
In rest of State	Dec. 1–Dec. 31.
Hare, rabbit	Oct. 1–Feb. 28.
Partridge, ruffed grouse	Oct. 1–Nov. 30.
Pheasant (male) in Hillsborough, Merrimack, Rockingham, and Strafford Counties only	Nov. 1–Nov. 6.
Woodcock	Oct. 1–Oct. 31.
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Sept. 16–Dec. 31.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Elk, moose, caribou, dove, quail, pheasant, European partridge; gray squirrel (1929); swans, wood duck, eider ducks, auks, bitterns, sand-hill crane, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game and fish, $15.15; fish, $3.15. Resident: Game and fish, $1.50. Resident soldiers and sailors more than 70 years of age may obtain license free on application to fish and game commissioner. Fishing licenses not required of children under 16 or of blind persons. Issued by commissioner or his agent in each town, who with few exceptions is the town clerk. Children under 16 may hunt without license when accompanied by licensed parent or guardian. Resident owner of farm lands and his minor children may hunt during open season on own land without license. Guide: Nonresident, $20; resident, $1. Issued by commissioner.

Bag limits and possession: One deer a season; 5 hares a day; 5 ruffed grouse a day, 25 a season; 2 pheasants a day, 5 a season; 4 woodcock a day, 25 a season; 20 ducks, 8 geese, 8 brant, 20 Wilson snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Deer may be possessed for a reasonable time after close of open season.

Interstate transportation: Export of all protected game prohibited, provided the head, hide, feet, or fur of game quadrupeds, and the plumage or skins of game birds (except migratory birds) legally taken and possessed may be transported in the State without being marked, but under Federal law all interstate shipments must be marked as to contents. Nonresident may take or ship out of the State, under his hunting license, one day's limit of game birds, and under license coupon, one deer. Shipments by common carrier must have attached tag showing number and kind of game, names of consignor and consignee, and point of shipment and destination, and the shipment or transportation of game must be indorsed on the back of shipper's license.

Deer must be tagged with license coupon before being moved.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all migratory birds prohibited. Sale for food purposes prohibited of the dead bodies of birds belonging to a family any species or subspecies of which is native to and protected by the State; provided deer, hares, and rabbits may be sold during the open season for consumption as food only within State.

NEW JERSEY

Open seasons:	*Dates inclusive*
Deer [52] (male, with horns not less than 3 inches long)	Dec. 17–Dec. 21.
Raccoon	Oct. 1–Dec. 15.
Rabbit,[53] gray,[53] fox, and black squirrels, quail, ruffed grouse (partridge), prairie chicken, English or ring-necked pheasant cocks (see exceptions)	Nov. 10–Dec. 15.
Exceptions: Quail in Bergen, Essex, Hudson, Hunterdon, Morris, Passaic, Somerset, Sussex, Union, and Warren Counties	Mar. 15, 1933.
Ruffed grouse in Essex, Hunterdon, Mercer, Middlesex, Monmouth, Somerset, and Union Counties	Mar. 9, 1932.
Duck (except wood duck and eider ducks), goose, brant, Wilson snipe or jacksnipe, coot	Oct. 16–Jan. 31.[54]
Woodcock	Oct. 15–Nov. 14.[54]
Rail (marsh hen), other than coot and gallinule	Sept. 1–Nov. 30.[54]
Gallinule	Oct. 16–Nov. 30.[54]

No open season: Does and fawns, wild turkeys, English or ring-necked pheasant hens, Hungarian partridge, reedbird, dove, swans, wood duck, eider ducks, auks, bitterns, little brown, sandhill, and whooping cranes, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident and alien: Game and fish, $10.50; fish (in fresh waters), $5.50. Resident male citizen above age of 14: Game and fish, $1.65. Special license to hunt woodcock from Oct. 1 to Nov. 9, fee $2, required in addition to regular hunting license; issued by commission. When applied for by parent or legal guardian, in discretion of commission, license may be granted to citizen between ages 10 and 14 to hunt when accompanied by adult holder of a general license: Fee, $1; issued only by commission. All other licenses, except as indicated, issued by county, city, or town clerk, salaried warden, or registrar of licenses. Licensee required to wear in a conspicuous place on his outer clothing a license button. Occupant of farm and immediate members of his family residing thereon with him may hunt or fish on such farm during open season without license. Hunting on occupied posted lands of another prohibited.

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[48] See page 24 for footnote.

[50] Citizen of any State must pay same fee for hunting or fishing license as charged nonresidents by his State of residence.

[51] *New Hampshire:* Governor and council may suspend open season in time of excessive drought or emergency.

[52] *New Jersey:* Wild deer may be taken only with shotgun not smaller than 12 gauge, which may not be loaded with a bullet or other missile larger than buckshot. Killing of a deer must be reported to commission or county warden within 48 hours. Landowner or his authorized agent may kill deer on his own cultivated land at any time; carcass of deer so killed is the property of the commission, and killing must be reported within 48 hours.

[53] Rabbits and gray squirrels may be killed or trapped on own premises by farmers or fruitgrowers under permit from Commission.

[54] Migratory game birds may not be killed at any time on Shark River, or the shores thereof, in Monmouth County.

Alien prohibited from hunting or owning shotgun or rifle unless he is owner of real property in New Jersey to the value of $2,000 above all incumbrances, in which case he may obtain nonresident and alien license.

Bag limits and possession: One deer a year; 2 English or ring-necked pheasant cocks a day, 30 a season; 6 rabbits, 6 gray squirrels, 10 quail, 3 ruffed grouse, 4 woodcock, 25 ducks, 8 geese, 8 brant, 20 snipe, 25 sora, and 25 in all of other rails (marsh hens), coots, and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day or in possession. Deer carcasses from another State or a State game preserve may be possessed at any time if properly tagged to show where killed; possession of other game permitted during first 10 days of close season.

Interstate transportation: Export of all protected game (except deer) prohibited, except that a nonresident licensee in one day may carry from State the daily bag limit of game, if open to view, but not more than two days' limit of game may be exported in one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: The sale of deer, squirrels, and all game birds is prohibited; rabbits may be sold during open season and 10 days thereafter; cottontail rabbits, Belgian hares, and jack rabbits legally killed and coming from another State may be sold at any time.

Miscellaneous: Unlawful to use shotgun or rifle holding more than two cartridges or that may be fired more than twice without reloading.

NEW MEXICO

Open seasons:[55]	*Dates inclusive*
Deer (with horns at least 6 inches in length), wild turkey, grouse, Abert and Arizona gray squirrels	Nov. 10–Nov. 20.
Bear	Oct. 10–Oct. 31.
Quail (except bobwhite)	Nov. 1–Dec. 31.
Prairie chicken	Sept. 1–Sept. 5.
Turtle dove and white-winged dove	Sept. 1–Dec. 15.
Duck, goose, brant, Wilson snipe, coot	Oct. 16–Jan. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Does, Sonoran deer, elk, mountain sheep, goat, antelope, buffalo, bobwhite quail, pheasant, ptarmigan, sage hen, swans, wood duck, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Big game, bird, and fish, $35.25; big game and bird, $30.25; big game, $25.25; bird, $10.25; fish: General, $3; limited, $1.25. Resident: Big game, bird, and fish, $5; big game and bird, $4.50; bird and fish, $4.50; big game, $3; bird, $2.50; fish: General, $2; limited, $1.25; guide, $5.25; duplicate, $1. Issued by county clerks and deputies designated by State warden. Fishing license not required of children under 14 years of age. Alien resident of New Mexico or an adjoining State not permitted to hunt or to own or possess shotgun or rifle in State.

Bag limits and possession: One deer, 1 bear, 5 squirrels, 2 wild turkeys, 10 prairie chickens, 5 grouse, a season or in possession; 15 quail, 5 prairie chickens a day or in possession; 25 doves, 20 ducks, 8 geese, 8 brant, 20 Wilson snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day or in possession. Possession permitted during open season and first 10 days of close season. Under permit, game, except migratory birds, may be held in storage for first 90 days of close season; migratory birds may be so held for a period of 10 days.

Interstate transportation: Export of all game taken in the State prohibited, except the following permits are required to ship game out by common carrier: Fee, $1.25 for 1 deer, 1 bear, and 2 turkeys, and 50 cents for bag limit of other birds and fish.

Game taken outside of State and legally exported, when accompanied by permit or proof of lawful possession, may be possessed under permit obtained from State game and fish warden during open season and first 90 days of close season, but migratory game birds may be possessed only during open season where taken and first 10 days of close of season.

Sale: Sale of all protected game taken in the State prohibited.

NEW YORK

Open seasons:[56]	*Dates inclusive*
Deer (with horns not less than 3 inches long) (see exceptions)[57]	Nov. 1–Nov. 15[58]
Exceptions: In Adirondack region[59]	Oct. 15–Nov. 15.
In towns of Jackson, Salem, and White Creek, Washington County	Nov. 7–Nov. 19.
In Greene County	Nov. 1–Nov. 8.
Bear	Oct. 15–Nov. 15.
Varying hare[56]	Oct. 15–Mar. 1.
Cottontail rabbit[56]	Oct. 15–Jan. 31.
Squirrel (black, gray[56])	Oct. 15–Nov. 15.[60]
Quail in Dutchess, Greene, Orange, Putnam, Rensselaer, Sullivan, and Westchester Counties only	Nov. 15–Nov. 30.
Pheasant, male only[56] (four days only)	Oct. 18 and 25. Nov. 3 and 10.

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[55] *New Mexico*: Commission may close season in any locality on any species, and may prohibit all hunting, in periods of extreme forest-fire danger, at such times and places as may be necessary.

[56] *New York:* Commission by order may further restrict taking or possession of game. Open seasons on upland game have been restricted to the following periods or closed as indicated: *Squirrel* (black, gray), in Genesee, Niagara, Ontario, Orleans, Rockland, and Seneca Counties, no open season. *Cottontail rabbit,* in Erie County, Oct. 15–Dec. 31; in Genesee County, Oct. 15–Dec. 31; in Niagara County, Oct. 15–Jan. 1; in Richmond County, Nov. 15–Dec. 31; in Rockland County, Nov. 1–Dec. 31. *Varying hare,* in Chautauqua County, Oct. 15–Jan. 14; in Fulton and Onondaga Counties, Oct. 15–Jan. 31; in Richmond County, Nov. 15–Dec. 31; in Cattaraugus and Genesee Counties, no open season. *Pheasant,* in Delaware and Essex Counties, no open season.

[57] Only shotguns may be used for deer except in Adirondack region (see footnote 59) and except in Columbia, Delaware, Greene, Orange, Rensselaer, Sullivan, and Ulster Counties.

[58] In Dutchess County deer may be taken only on own land by owner or member of his immediate family.

[59] The Adirondack region comprises the counties of Clinton, Essex, Franklin, Fulton, Hamilton, Herkimer, Jefferson, Lewis, Oneida, Oswego, Saratoga, St. Lawrence, Warren, and Washington.

[60] In corporate limits of city or village squirrels may be taken only under permit of commission.

Open seasons—Continued.	*Dates inclusive*
Waterfowl, Wilson snipe or jacksnipe, coot	Sept. 24–Jan. 7.
Woodcock	Oct. 15–Nov. 14.
Rail and gallinule, other than coot	Sept. 24–Nov. 30.

No open season: Elk, moose, caribou, antelope, fawns; fox squirrel; grouse, partridge (Oct. 1, 1929); Hungarian or European gray-legged partridge, dove, quail (except as above), swans, wood duck, eider ducks, auks, bitterns, sand-hill and whooping cranes, fulmars, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting, trapping, and fishing licenses (combined): Nonresident: $10.50; fish only, $5.50. Resident, $1.25. Special deer license: Nonresident or alien, $10.50; resident, $1.25. Issued by county, city, town, and village clerks where population exceeds 5,000; elsewhere by department and inspectors and protectors; license not issued to minor under the age of 16. Indian resident or member of Six Nations residing on any reservation wholly or partly within State, $1.25. Only licensed Indians residing on a reservation may hunt thereon. Licensee required to wear button. Fishing license not required of women who are bona fide residents of State nor of minors under 16 years of age. Owners or lessees, and members of immediate families who are citizens actually occupying cultivated farmland may hunt thereon without license during open season. Guide (required in forest reserve counties), license fee, $2; issued by commissioner. Alien not permitted to hunt except under special license from conservation commission, or to own or possess shotgun or rifle.

Bag limits: One deer, 1 bear, 3 male pheasants a season; 4 woodcock a day, 24 a season; 6 varying hares or rabbits, 5 squirrels, 25 ducks, 8 geese, 8 brant, 25 in all of rails, coots, and gallinules, but not more than 15 of any one species, 20 Wilson snipe or jacksnipe a day.

Local bag limits: Quail, 4 a day, 10 a season, in Dutchess, Greene, Orange, Putnam, Rensselaer, Sullivan, and Westchester Counties.

Possession: Deer, squirrel, grouse, and pheasant during open season and 5 days thereafter; migratory game birds during open season and 10 days thereafter. Deer properly tagged may be possessed under $1 permit to Feb. 1.

Interstate transportation: Export of game and birds prohibited, except that any person may export one deer, one bear, and one day's bag limit of other game in one day during open season by means other than parcel post. The taker may export in one day by common carrier, except parcel post, one day's limit when accompanied by permit, which shall show contents of package. Head, hide, and feet of animals and plumage or skin of game birds legally taken may be exported at any time.

Game taken outside of State and legally exported may be brought into State during open season therein and possessed the same as if taken in State. Migratory game birds may be possessed during open season where taken and first 10 days of close season. Importation permit, fee $1, obtained from conservation department, required to import game during close season, and then game birds must be accompanied by taker, while quadrupeds bearing New York importation tags may be shipped by common carrier, but not by parcel post. Game other than migratory birds imported under importation permit may be possessed at any time by permit holder for private consumption.

Sale: Sale of all game, except varying hares and rabbits, prohibited; varying hares and rabbits legally taken in State may be sold during open season, and when brought from without the State may be sold at any time.

Head, hide, and feet of quadrupeds legally taken and possessed may be sold at any time.

Miscellaneous: Hunting prohibited on lands supplying any municipality with water or on public highways, except public highways within forest preserve counties.

NEW YORK—Long Island

Open seasons:	*Dates inclusive*
Deer (with horns not less than 3 inches long)	Nov. 1–Nov. 15.
Squirrel (black, gray), quail, pheasant (male only)	Nov. 1–Dec. 31.
Varying hare	Oct. 15–Mar. 1.
Cottontail rabbit	Nov. 1–Dec. 31.
Waterfowl, Wilson snipe or jacksnipe, coot, mud hen	Oct. 16–Jan. 31.
Woodcock	Oct. 15–Nov. 14.
Rail and gallinule, other than coot	Sept. 24–Nov. 30.

No open season: Fox squirrel, ruffed grouse, partridge (Nov. 1, 1929); dove, swans, wood duck, eider ducks, auks, bitterns, sand-hill and whooping cranes, fulmars, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Bag limits and possession: Six quail a day, 40 a season; 4 male pheasants a day, 30 a season. For other bag limits see New York.

Hunting licenses, interstate transportation, sale, miscellaneous: (See New York.)

NORTH CAROLINA [61]

Open seasons:	*Dates inclusive*
Deer (male), bear	Oct. 1–Jan. 15.
Rabbit	Nov. 1–Mar. 1.
Squirrel	Sept. 15–Jan. 15.
Quail, ruffed grouse, wild turkey, Mongolian, Chinese, or ring-necked pheasant	Dec. 1–Mar. 1.
Dove	Sept. 16–Dec. 15.
Woodcock	Dec. 1–Dec. 31.
Duck, goose, brant, coot, Wilson snipe or jacksnipe	Nov. 1–Jan. 31.[62]
Rail (except coot and gallinule)	Sept. 1–Nov. 30.
Gallinule	Nov. 1–Nov. 30.

No open season: Buffalo, elk; does (1932), swans, wood duck, reedbirds, auks, bitterns, gannet, grebes, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Game, $15.25;[63] fish, $3.10. Resident: Game, $5.25 (State license); $1.25 (county license); fish, $1.10 (county license); $2.10 (State license). Issued by clerk, superior court, wardens, and deputies. Person under 16 who is member of family resident of State may hunt under license of his parent or guardian; nonresident minor child of a resident may procure and use resident hunting license when actually visiting such resident parent. Resident landowner and dependent member of his family under 21 may hunt on own land during open season without license. Lessee of farm for cultivation may hunt thereon without license. Fishing license only required for fresh waters, but not of person fishing in waters on his own land nor of person who accompanies such owner or has his written permission to fish in such waters. Fishing licensee must wear license button.

Bag limits and possession: Two deer a day or in possession at one time, 4 a season; 2 wild turkeys a day or in possession at one time, 5 a season; 10 squirrels, 10 quail, 25 in all of ruffed grouse and introduced pheasants, 4 woodcock, 25 doves, 25 ducks, 8 geese, 8 brant, 20 Wilson snipe or jacksnipe, and 25 in all of rails, coots, and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day.

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[61] *North Carolina:* On petition of 25 or more reputable citizens and after public hearing, duly advertised, department of conservation and development may change, close, or reopen seasons within the dates specified for the State or any county or district thereof or change the bag limits when special circumstances make such changes desirable and may designate days in each week on which migratory waterfowl may not be taken.

[62] Rest days prescribed for waterfowl by certain county laws. Special regulations affecting waterfowl in Currituck, Dare, and Hyde Counties may be obtained from clerks of counties named.

[63] Boards of county commissioners may prescribe additional license fees for nonresidents hunting in their respective counties.

The game allowed in possession at one time is restricted to one day's limit on deer and wild turkeys and three days' limit on other game animals and birds.

Rabbits and squirrels lawfully taken may be possessed during open season and first five days of close season. Other game animals and birds may be possessed during open season and first 10 days of close season.

Interstate transportation: Export of all protected game prohibited, except that a nonresident licensee, under permit from State warden may export not more than 2 male deer and 2 wild turkeys a season and not more than two days' limit of other game animals and birds a calendar week in any manner except by parcel post, if the outside of the package in which such game is transported is clearly marked with the names and addresses of the consignor and consignee and an accurate statement of the number and kind of game contained therein.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited except rabbits and squirrels during open season.

NORTH DAKOTA [64]

Open seasons:	*Dates inclusive*
Prairie chicken (pinnated grouse), sharp-tailed (white-breasted) grouse, Wilson snipe	Sept. 16–Oct. 16.
Woodcock	Oct. 1–Oct. 16.
Duck, goose, brant	Sept. 16–Dec. 1.

No open season: Deer, elk, moose, antelope, quail, ruffed grouse, sage hen, English and Chinese ring-necked pheasants, Hungarian partridge, dove, rail, coot, gallinule, swans, wood duck, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $25; fish, $3. Resident: Game, $1.50; fish, 50 cents; taxidermist, $1. Issued by commissioners, deputy, or county auditor. Fishing license not required of resident under 16 and nonresident under 12 years of age. Aliens not permitted to hunt. Person or member of family permanently residing with him may hunt, trap, or fish without license during open season on own lands or lands cultivated by him. Resident license may be issued to settler. No person permitted to enter cultivated or posted lands without consent of owner.

Bag limits and possession: Five prairie chickens, sharp-tailed grouse, each or all combined a day, 10 each or all in possession at one time; 15 snipe, woodcock, ducks, geese, each or all combined a day, but not more than 8 geese, 8 brant, or 4 woodcock, 30 in possession but not including more than 16 geese; 25 coots, 25 sora, 25 in all of rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Resident licensee under permit may retain not to exceed 20 pinnated or sharp-tailed grouse, 30 waterfowl, but not more than 50 birds in all during first 5 days of close season.

Interstate transportation: Export of all protected game prohibited, except that nonresident licensee may carry with him from State under license tag 2 days' limit of game, if open to view and labeled with his name and address and number of his license. Not more than 2 days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed under storage permit, obtained from secretary, game and fish board, in like numbers and manner as game taken in State, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited, except that hides, heads, and trophies of big game lawfully taken may be sold at any time.

OHIO

Open seasons:	*Dates inclusive*
Hare, rabbit	Nov. 15–Jan. 1.[65]
Squirrel (season closed in odd, open in even years)	Oct. 1–Oct. 15.
Cock pheasant (introduced), Hungarian partridge	Nov. 15–Nov. 25.
Duck, goose, brant, Wilson snipe, coot	Sept. 16–Dec. 31
Woodcock	Oct. 15–Nov. 14.
Rail, other than coot and gallinule	Nov. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Deer, quail, ruffed grouse, hen pheasants, dove, swans, wood duck, eider ducks, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: General, $15.25; fish, $2.25 (rod and reel). Resident citizen: Game, $1.25; fish, $1.10 (rod and reel). Issued by county and township clerks. Rod and reel license not required of persons under 18 years of age. Persons under 16 when hunting with a gun must be accompanied by adult. Owners, tenants, or their children may hunt or fish without license during open season on own or leased lands. Written permission required to hunt on land of another.

Bag limits and possession: Four squirrels and 5 rabbits a day or in possession; 2 cock pheasants a day, 4 in possession; and 6 Hungarian partridges, 15 Wilson snipe, 4 woodcock, 8 geese, 25 ducks, 25 coots, 25 sora, and 25 in all of other rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules, and not more than 25 coots and gallinules a day. Waterfowl, coots, and gallinules may be possessed during first 10 days of close season.

Interstate transportation: Export prohibited of all protected game (except rabbit) taken in State; provided, a nonresident may take with him from State under his hunting license 25 game animals killed by himself Packages containing game or fur-bearing animals or parts thereof must be marked to show contents, initial point of billing, and names and addresses of consignor and consignee.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game (except hare or rabbit during open season).

OKLAHOMA

Open seasons:	*Dates inclusive*
Bear [66]	
Squirrel	July 1–Jan. 31.
Quail	Nov. 20–Jan. 2.[67]

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[64] *North Dakota*: The governor, on recommendation of game and fish commission, may by order close or open seasons, fix bag limits, or prescribe manner in which game may be taken, but such orders may not extend the open seasons or other provisions of the Federal regulations on migratory birds.

[65] *Ohio*: Landowners, tenants, and employees may take hares or rabbits, when doing substantial damage to crops, trees, or shrubbery, at any time except on Sunday.

[66] *Oklahoma;* Bear in Blaine, Caddo, Comanche, Kiowa, and Major Counties, no open season; in rest of State, no close season.

[67] Quail may not be hunted except on Monday, Wednesday, and Friday, of each week during open season and on Thanksgiving Day and on Christmas and New Year's Days or the preceding Saturdays if they fall on Sundays.

Open seasons—Continued.	*Dates inclusive*
Duck, goose, brant, Wilson snipe or jacksnipe, coot	Oct. 1–Jan. 15.
Dove	Sept. 1–Dec. 15.
Woodcock	Nov. 15–Dec. 15.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer (1931); antelope, wild turkey, prairie chicken, imported pheasant, swans, wood duck; bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Game: Nonresident, $15; alien, $25; resident citizen, $1.25. Fish: Nonresident, $5; resident (to use rod and line for game fish), $1.25. Issued by warden, deputy, or county clerk. A person may hunt without license during open season on own or leased premises actually occupied by him. Fishing license not required of any person under 16 nor of women. Application of person under 14 for a hunting license must be approved in writing by parent or guardian. Women required to have hunting licenses. Unlawful to shoot on or across highway or railroad right of way. Unlawful to hunt on lands of another without owner's permission.

Bag limits and possession: Six squirrels a day; 10 quail a day, 50 a season; 10 ducks a day, 50 a season; 4 geese a day, 12 a season; 8 brant a day; 20 Wilson snipe a day, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, 25 doves, and 4 woodcock a day. Possession of game permitted during first 10 days of close season, and trophies or specimens of game lawfully taken may be possessed at any time.

Interstate transportation: Export prohibited of all protected game, but nonresident licensee may carry to his home two days' bag limit of game birds if license permit is attached.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game.

OREGON [68]

Open seasons:	*Dates inclusive*
District No. 1,[69] *west of Cascades:*	
Deer (male, with horns)	Sept. 10–Oct. 20.
Bear in Jackson and Josephine Counties	Nov. 1–Nov. 30.
In rest of district 1	No close season.
Silver-gray squirrel (see exception)	Sept. 15–Oct. 15.
Exception: In Benton, Clackamas, Douglas, Josephine, Lane, Linn, Marion, Multnomah, Polk, Washington, and Yamhill Counties	No close season.
Mountain or plumed and California or valley quail in Coos, Curry, Jackson, and Josephine Counties only	Oct. 15–Oct. 31.
Blue or sooty grouse, ruffed grouse or native pheasant, Chinese pheasant (see exception)	Oct. 15–Oct. 31.
Exception; In Clatsop, Curry, Lincoln, and Tillamook Counties	No open season.
Duck, goose, brant, coot, Wilson snipe or jacksnipe	Oct. 1–Jan. 15.
Rail and gallinule, other than coot	Oct. 1–Nov. 30.

Open seasons—Continued.	*Dates inclusive*
District No. 2,[69] *east of Cascades;*	
Deer (male, with horns)	Sept. 10–Oct. 20.
Bear in Klamath County	Nov. 1–Nov. 30
In rest of district 2	No close season.
Silver-gray squirrel	Sept. 15–Oct. 15.
Mountain or plumed and California or valley quail in Deschutes, Gilliam, Klamath, Lake, Morrow, Umatilla, and Wasco Counties only	Oct. 15–Oct. 31.
Blue or sooty grouse, ruffed grouse or native pheasant	Sept. 10–Oct. 20.
Hungarian partridge in Morrow, Umatilla, and Wallowa Counties only	Oct. 1–Oct. 31.
Chinese pheasant in Baker, Gilliam, Grant, Hood River, Klamath, Morrow, Umatilla, Union, Wallowa, and Wasco Counties only on Wednesdays and Sundays	Oct. 1–Oct. 31.
In Malheur County	Oct. 1–Oct. 31.
Duck, goose,[70] brant, coot, Wilson snipe or jacksnipe	Oct. 1–Jan. 15.
Rail and gallinule, other than coot	Oct. 1–Nov. 30.

No open season: Doe and spotted fawn, moose, elk, antelope, mountain sheep, mountain goat, Franklin grouse, fool hen, wild turkey, quail and introduced pheasants (except as above), bobwhite quail, sage hen, prairie chicken, dove; band-tailed pigeons, swans, wood duck, auklets, auks, bitterns, little brown and sand-hill cranes, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: (reciprocal fees—applicant pays same fees for hunting, angling, or combination licenses as charged nonresident by State of which he is a resident). Alien: Gun license, $25 (in addition to hunting and angling license). Resident, game and fish, $5; game, $3; hunting or angling, $1.50 (county license issued to residents between 14 and 18 years of age). Angling, resident, $3. License issued by county clerks and duly appointed agents throughout the State. Guide, $3 (issued only to citizens of United States); taxidermist, $5; issued by commission. Licenses not issued to persons under 14 years of age. Owner and member of his family may hunt, trap, or fish on own premises without license during open season. Licenses, good for life, issued free of charge by State Game Commission to pioneers of State who arrived prior to 1870, veterans of Indian and Civil Wars, residents of State Soldiers' Home and veterans of World War who are disabled. Unlawful to hunt on inclosed or occupied land of another without permission of owner. Unlawful to shoot from highway or railroad right of ways, or within cemeteries or incorporated towns.

Bag limits and possession: Two deer a season; 5 silver-gray squirrels in 7 consecutive days; 10 quail in district 1, and 8 in district 2 in 7 consecutive days; 4 in all of ruffed grouse, pheasants, sooty or blue grouse and west of Cascades Chinese pheasants a day, 8 in 7 consecutive days, but a bag of 8 shall not include more than 1 Chinese pheasant hen, but east of Cascades Chinese pheasants have a separate limit of 4 a day, 8 in 7 consecutive days, but not more than 1 hen may be taken in 7 consecutive days; 4 Hungarian partriges a day, 8 in 7 consecutive days, 25 in all of duck, geese, Wilson snipe, rails, coots, and gallinules a day, but not more than 8 geese or 15 of any one species of rails (other than sora) and gallinules a day, and not more than 25 in all a day nor more than 30 in all in 7 consecutive days.

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[68] *Oregon:* Commission may open or close season on any species of game birds in any county or district for such time as it may designate and governor may suspend season on account of fire hazard in forest area.

[69] District No. 1, west of Cascades, includes Benton, Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties. District No. 2, east of Cascades, includes all other counties in the State.

[70] Unlawful to kill geese or other wild bird or animal at any time on islands or sand bars or within one-fourth mile of high-water line on the Columbia east of eastern entrance of Celilo Canal or on islands and sand bars in Deschutes and John Day Rivers south to junction with White River and Thirtymile Creek, respectively.

Migratory game birds properly tagged may be possessed during first 10 days of close season; other game, when properly tagged, during close season.

Interstate transportation: Export of all protected game prohibited, except when tagged with metal seal and accompanied by permit from State warden showing kind of game and names and addresses of consignor and consignee.

Game taken outside of State and legally exported may be imported and possessed as authorized by permit and tag, fee 5 cents, obtained from State game warden, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited. Commission may make regulations permitting sale of game except migratory birds.

PENNSYLVANIA

Open seasons:[71]	*Dates inclusive*
Deer (without horns, weighing not less than 50 pounds with entrails removed), bull elk (with 4 or more points to 1 antler)	Dec. 1-Dec. 15.[72]
Bear (over 1 year old)	Nov. 1-Dec. 15.[71] [72]
Raccoon	Oct. 15-Nov. 30.[73]
Squirrels (black, gray, fox)	Oct. 15-Nov. 30.[71]
Red or pine squirrel	Oct. 15-Aug. 15.[71]
Hare, rabbit	Nov. 1-Dec. 15.[71]
Ruffed grouse, male ring-necked pheasant, quail, Wilson snipe, wild turkey (see exceptions).	Oct. 15-Nov. 30.[71]
Exception: Wild turkey in Fayette, Somerset, and Westmoreland Counties (1931).	
Woodcock	Oct. 15-Nov. 14.[71]
Duck, goose, brant	Oct. 15-Jan. 15.
Coot	Oct. 15-Nov. 30.[71]
Rail and gallinule	Sept. 1-Nov. 30.[71]

No open season: Cow elk and calves having less than 4 points to one antler; doe, fawn; bear cub under 1 year of age; Hungarian partridge or quail; pheasant hens, dove, swans, wood duck, eider ducks, blackbird, reedbird, auks, bitterns, little brown and sand-hill cranes, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: *Game:* Nonresident, $15 (does not authorize killing deer in 1928). Issued by commission or county treasurer. Resident, $2 (additional $2 special license also must be obtained from board for killing deer in 1928); through justice of peace, magistrate, or notary public, $2.15. Licenses not issued to minors under 14 years of age, and minors between 14 and 16 must furnish written consent of parent or guardian. Licensee required to wear tag displayed on middle of back.

Resident citizen and members of family or employees residing upon and cultivating land in State as either owner or lessee may hunt during open season on such land and with consent of owner, on adjoining land without a license. Taxidermist license, fee $1.

Licensed hunters, within 30 days after expiration of license, must report amount of game killed.

Aliens not permitted to hunt or be possessed of dogs or firearms.

Fishing: Nonresident pays same fee charged nonresident by State where applicant resides, but not less than $2.50 (10 cents extra to county treasurer); issued by county treasurer or commissioner of fisheries or his agents.

Resident, $1 (10 cents extra to county treasurer); issued by county treasurer, commissioner of fisheries, his officers or agents. License not required of minors under 16. Persons and members of family who reside upon their own farms or other lands throughout the entire year may angle in waters on or adjacent thereto during open season without license.

Bag limits and possession: One deer (party camping or hunting together, 1 per member), 1 elk (1 to hunting party), 1 bear (4 to hunting party), 1 wild turkey, 30 rabbits, 15 hares, 20 squirrels, 25 quail (combined), 15 ruffed grouse, 6 male ring-necked pheasants, 20 woodcock, 60 ducks, 30 geese, 30 brant a season. Five rabbits, 3 hares, 6 squirrels (black, gray, fox), 8 quail (combined), 3 ruffed grouse, 2 male ring-necked pheasants, 4 woodcock, 15 ducks, 5 geese, 5 brant, 20 Wilson snipe, 25 coots, 25 sora, 25 in all of other rails and gallinules but not more than 15 of any one species of rails (except sora) and gallinules, a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 30 days thereof.

Interstate transportation: Export of all protected game taken in State prohibited; provided, a nonresident licensee may take out with him on same conveyance two days' limit of game except elk. Small game must be accompanied by owner and if concealed must be tagged to show name and address of owner, county where killed, and number of each species in package. Large game may be shipped by express when plainly marked to show name and address of owner and county in which killed. Specimens of game legally taken may be shipped to a licensed taxidermist for mounting, but shipment of game by parcel post prohibited, except that skins of raccoon, bear, and trophies to licensed taxidermists may be so shipped, if marked to show contents, but no such shipments may be made to points outside the State without a permit.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale prohibited of wild deer and rabbit taken in the State, and of all other game wherever taken. Trophies of game not killed in State and skins of bears and raccoons wherever taken may be purchased or sold at any time.

Miscellaneous: Automatic gun prohibited.

RHODE ISLAND

Open seasons:	*Dates inclusive*
Gray squirrel (see exception) hare, rabbit	Nov. 1-Dec. 31.
Exception: Gray squirrel on Conanicut Island	No open season.
Quail or bobwhite, ruffed grouse or partridge, cock pheasant	Nov. 1-Dec. 31.
Duck, goose, brant, coot	Oct. 1-Jan. 15.
Wilson snipe	Oct. 1-Nov. 30.
Woodcock	Nov. 1-Nov. 19.
Rail and gallinule, other than coot	Sept. 1-Nov. 30.

No open season: Deer,[74] dove; Hungarian partridge; hen pheasant, swans, wood duck, eider ducks, auks, bitterns, little brown and sand-hill cranes, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $10.25; fish, $2.50.[75] Alien: Game, $15.25;

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[71] *Pennsylvania:* Prior to December 1, hunting permitted only on Thursday, Friday, and Saturday of each week, except for raccoons, and ducks, geese, and brant. Seasons may be extended, closed, or shortened and bag limits reduced by commission.

[72] In killing deer, elk, or bear, only one all-lead, lead-alloy, soft-nosed, or expanding bullet may be used at each discharge. The use of steel-jacketed bullets is prohibited.

[73] Trapping of raccoons permitted only during November.

[74] *Rhode Island:* Deer injuring crops may be killed at any time by owner or occupant of premises under written permit from secretary of State. Any person killing or wounding a deer must report within 48 hours to commissioners of birds.

[75] Fee required of nonresident angler equal to that required of nonresident in his State of residence.

fish, $2.50, alien resident for 1 year; $5, alien, not resident for 1 year. Resident: Game, $2.25; fish, $1.25. Issued by city and town clerks. Fishing license not required of women, nor of males under 18. License not required of resident or his immediate family to hunt on own or leased agricultural lands on which actually domiciled; nonresident owning real estate valued at not less than $500, and nonresident member or guest of club incorporated for hunting or fishing purposes prior to Jan. 1, 1909, which owns real estate assessed for taxation at value of not less than $1,000, may procure license at a fee of $2.25; licenses not issued to minors under 15. Consent of owner required for hunting upland game birds on land of another from January 1 to October 31.

Bag limits and possession: Two ruffed grouse or partridge, 3 cock pheasants, 6 quail, 15 ducks, 8 geese, 8 brant, 4 woodcock, 15 Wilson snipe, 15 coots, 15 rails, 25 in all of rails and gallinules a day, but not more than 15 of any one species of gallinules, and not more than 15 game birds of all kinds (other than waterfowl, coots, and gallinules) in possession at one time. Possession of waterfowl, coots, and gallinules permitted during first 10 days of close season.

Interstate transportation: Export of all game prohibited; provided, a nonresident licensee may take out under his license 10 wild fowl or birds in one calendar year, if carried open to view.

Game taken outside of State and legally exported may be imported and possessed as authorized by permit from commissioners of birds, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all game birds prohibited.

SOUTH CAROLINA[76]

Open seasons:	*Dates inclusive*
Deer (male)	Aug. 15–Jan. 1.
Rabbit,[77] squirrel,[77] quail (partridge), wild turkey, blackbird	Nov. 29–Mar. 1.[78]
Raccoon, opossum	Sept. 1–Mar. 1.
Woodcock	Dec. 1–Dec. 31.
Dove	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Duck, goose, brant, coot, Wilson snipe	Nov. 1–Jan. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Does, ruffed grouse (pheasant), swans, wood duck, reedbirds, auks, bitterns, little brown, sand-hill, and whooping cranes, gannet, grebes, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15.25; fish, $3.25. Issued by county game warden. Resident: Game, State, $3.10; county of residence, $1.10. Issued by county game warden and his agents.

No license required of resident owners, tenants, their children, or, under written permission, their employees, to hunt during open season on own lands. Confederate veteran wearing his cross of honor may hunt and fish in any county of State without license.

Consent of owner or manager required to hunt on land of another.

Hunting clubs and game preserves must register with chief game warden of State, file list of members including names and addresses, and during March of each year report number and kind of game killed by members during season.

Bag limits and possession: Five deer, 20 wild turkeys a season; 15 squirrels, 15 quail (partridges), 2 turkeys, 25 doves, 25 ducks, 8 geese, 8 brant, 4 woodcock, 20 Wilson snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession of migratory birds permitted during first 10 days of close season.

Interstate transportation: Export of all resident nonmigratory game taken in State prohibited, except that a landowner or licensee may export under shipping tag from chief game warden of State 1 day's bag limit of resident nonmigratory game a week, if not for sale. Unlawful for any transportation company to receive for shipment out of the State any deer or other resident nonmigratory game unless duly tagged. Under Federal regulations not more than two days' limit of migratory birds may be taken or shipped out of the State in any one calendar week. All packages containing migratory birds must be marked to show actual contents and names and addresses of consignor and consignee. No game may be removed from the State for sale.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of deer, quail (partridges), dove, turkey, reedbirds, and all other migratory birds.

SOUTH DAKOTA

Open seasons:	*Dates inclusive*
Deer (male) (see exception)	Nov. 1–Nov. 30.
Exception: In Campbell, Corson, Dewey, Harding, Perkins, Potter, Walworth, and Ziebach Counties	No open season.
Duck, goose, brant, coot, Wilson snipe	Sept. 16–Dec. 31.
Rails and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Does, elk, antelope, mountain sheep, quail, Hungarian partridge, dove, partridge or ruffed grouse, prairie chicken or pinnated grouse, white-breasted or sharp-tailed grouse, sage grouse, introduced pheasants,[79] upland plover, woodcock, swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, heron, loons, shearwaters, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Big game, $25; small game, $25; fish, $2. Issued by game warden or county treasurer. Resident: Big game, $5; small game and fish, $1; issued by county treasurer, game and fish commission, and deputies; special license, small game, $3 (hunting; also authorizes shipment of 50 birds as specified in license); issued by game and fish commission. Fishing license not required of women, or of males under 18 years of age. Hunting and fishing license not issued to persons under 15 unless applied for by parent or guardian. Hunting game birds during open season on own land permitted without license. Unlawful to hunt on posted land of another without permission of owner. Taxidermist, $2.

Bags limits and possession: One deer a year; 15 ducks, geese, brant, Wilson snipe, coots, gallinules, sora, and other rails in the aggregate of all kinds a day, 30 in all in possession (but not more than 5 geese and brant a day, 10 in possession). Possession permitted during open season and 5 days thereafter.

Interstate transportation: Export of all protected game prohibited; provided, a nonresident may export 1 deer lawfully killed under permit of game and fish commission and not more than 10 birds under each of the 5 coupons attached to his nonresident license; but not more than 50 ducks, 16 geese, 16 brant, 50 coots, 40 snipe, and 50 in all of rails and gallinules, but not more than 30 of any one species of rails (other than sora) and gallinules may be exported by one person in any one calendar week, and if exported by common carrier or as personal baggage tags attached to hunting license must be affixed to each shipment.

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[76] *South Carolina:* Chief game warden of State may close seasons for periods not exceeding 10 days at one time on any waters or swamps of State when necessary to protect deer or other game on account of floods or other abnormal conditions; and on recommendation of any county legislative delegation may shorten season on any kind of game.

[77] Between Sept. 1 and Thanskgiving Day rabbits may be hunted without firearms, and squirrels may be hunted without dogs.

[78] Season opens on Thanksgiving Day.

[79] *South Dakota:* Chinese, ring-necked, or English pheasant, partridge or ruffed grouse, prairie chicken or pinnated grouse, white-breated or sharp-tailed grouse, and sage grouse may be taken under regulations of game and fish commission, Pierre.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited; provided skins, heads, and antlers of deer lawfully killed may be sold.

TENNESSEE

Open seasons:	*Dates inclusive*
Deer (male, with horns having 2 or more spikes each) (see exception)	Dec. 20–Dec. 31.
Exception: In Cheatham County	No open season.
Squirrel (see exceptions)	June 1–Jan. 1.
Exceptions: In Decatur County (also May 1–Aug. 1)	Oct. 1–Feb. 1.
In McNairy County (also June 1–July 31)	Oct. 1–Jan. 31.
In Cannon and Wilson Counties	No close season.
Rabbit (see exceptions)	No close season.
Exceptions: In Coke, Davidson, Hamilton, Hardin, Hawkins, Jefferson, Johnson, Lawrence, Madison, and Sullivan Counties	Nov. 15–Feb. 15.
In Haywood and McNairy Counties	Dec. 10–Feb. 14.
In Hardeman County	Oct. 25–Mar. 1.
Quail or partridge (see exceptions)	Nov. 25–Feb. 1.
Exceptions: In Decatur County	Dec. 10–Feb. 20.
In Fayette County	Dec. 10–Feb. 15.
In Lauderdale and Hardin Counties	Dec. 10–Mar. 1.
In Haywood County	Dec. 10–Feb. 14.
In Madison County	Nov. 24–Feb. 1.
In McNairy County	Dec. 20–Feb. 15.
In Robertson County	Nov. 15–Jan. 31.
In Sullivan County	Nov. 25–Jan. 1.
In Washington County	Nov. 25–Jan. 15.
In Claiborne and Monroe Counties	No open season.
Wild turkey in Lauderdale County only	Nov. 1–Jan. 25.
Duck, goose, brant, coot, mudhen, Wilson snipe or jacksnipe	Nov. 1–Jan. 31.
Dove (see exception)	Sept. 1–Dec. 15.
Exception: In Claiborne County	No open season.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Nov. 1–Nov. 30.

No open season: Does and fawns; wild turkey, grouse, ring-necked and Mongolian pheasants, woodcock, swans, wood duck, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15 (may hunt on own land without license); fish, $2.50. Resident, State, $2 (resident must hold State license to hunt on Reelfoot Lake); county, $1 (county licensee may obtain State license for $1). Issued by county clerks. Licensee required to wear license tag displayed in center of back of outer garment.

Owners and tenants may hunt without license on land on which they reside. Unlawful to hunt on tillable or inclosed lands of another without permission.

Reelfoot Lake.—Guide or pusher, $1 (issued to residents only).

Bag limits and possession: Two deer a season; 15 quail, 20 other game birds or animals a day, but not more than 8 geese, 8 brant, 15 of any one species of rails (other than sora) and gallinules a day.

Reelfoot Lake.—Twenty ducks, 8 geese, 8 brant, 20 Wilson snipe, 20 in all of rails, coots, and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, but not more than 20 in all of game birds a day.

Interstate transportation: Export of all protected game prohibited; provided, nonresident licensee may take out of State, if carried openly, game birds legally killed by him (except that 25 birds only may be exported from Reelfoot Lake), but not more than 50 ducks, 16 geese, 16 brant, 40 Wilson snipe, 50 coots, 50 sora, 50 in all of rails and gallinules, but not more than 30 of any one species of rails (other than sora) and gallinules, and 50 doves may be exported by one person in any one calendar week.

No restrictions on export of rabbits except in counties where protected.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game (except rabbits) killed in State prohibited.

TEXAS

Open seasons:	*Dates inclusive*
Deer (male with pronged horn), bear	Nov. 16–Dec. 31.
Squirrel (see exception)	May 1–July 31. Oct. 1–Dec. 31.
Exception: in Austin, Bandera, Brown, Burnet, Caldwell, Colorado, Comal, De Witt, Edwards, Fayette, Gillespie, Goliad, Gonzales, Guadalupe, Jackson, Kendall, Kerr, Kimble Lavaca, Llano, McCulloch, Mason, Medina, Menard, Mills, Real, San Saba, Schleicher, Uvalde, Victoria, and Wharton Counties	No close season.
Quail or partridge, chachalaca or Mexican pheasant	Dec. 1–Jan. 16.
Prairie chicken or pinnated grouse (see exception)	Sept. 1–Sept. 10.
Exception: In Collingsworth, Donley, Gray, and Wheeler Counties	Sept. 1, 1929.
Wild turkey gobblers (see exception)	Nov. 16–Dec. 31.
Exception: In Brooks, Cameron, Hidalgo, Kleberg, Nueces, Kenedy, Starr, and Willacy Counties	Nov. 16, 1930.
Mourning dove, in north zone	Sept. 1–Oct. 31.[80]
In south zone	Nov. 1–Dec. 31.[80]
White-winged dove	July 1–Sept. 30.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, in north zone	Oct. 16–Jan. 31.[80]
In south zone	Nov. 1–Jan. 31.[80]
Rail, other than coot and gallinule	Sept. 1–Oct. 31.
Gallinule, in north zone	Oct. 16–Nov. 30.[80]
In south zone	Nov. 1–Nov. 30.[80]

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[80] *Texas:* North and south zones divided by a line running approximately from the Rio Grande River east through Del Rio, thence following center of the main track of Southern Pacific Railroad through Spofford, Uvalde, and Hondo to San Antonio; thence following International & Great Northern Railroad to Austin; thence along Houston & Texas Central Railroad through Elgin, Giddings, and Brenham to Brazos River; thence with center of Brazos River to Beaumont branch of Santa Fe Railway; thence following Gulf, Colorado & Santa Fe Railroad through Navasota, Montgomery, and Conroe to Cleveland; thence along Houston, East & West Texas Railroad to point where it strikes Louisiana line. For detailed boundary line see Service and Regulatory Announcements—B. S. No. 70, obtainable from Bureau of Biological Survey, Washington, D. C., or State game law to be had from game, fish, and oyster commissioner, Austin, Tex.

No open season: Does, fawns, spike bucks, antelope, mountain sheep, turkey hens, robins, pheasant (except chachalaca), woodcock, swans, wood duck, bitterns, little brown, sand-hill, and whooping cranes, gannet, grebes, gulls, herons, jaegers, loons, petrels, band-tailed pigeons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Game, $25; fish (artificial lure), $5; nonresident, 5-day license, $1.10. Resident citizen: Game, $2; not required in county of residence; fish (artificial lure), $1.10; issued by commissioner, deputies, and county clerks. Boat (carrying hunters), $2; club or shooting preserve, $5. Issued by commissioner. Manager of club or shooting preserve must keep record, require guests to register number of game killed, and make complete report to commissioner by Feb. 10 of each year. Hunting license not required of persons under 17. License does not entitle holder to hunt on inclosed and posted lands of another without consent of owner or agent.

Bag limits and possession: Two deer, 1 bear, 3 turkey gobblers a season; 10 squirrels a day; 12 in all of quail and chachalacas a day, 36 in 7 days, 36 of each in possession; 5 prairie chickens a day, 10 a season; 15 doves and white wings a day, 45 in 7 days or in possession; 25 in all of ducks, rails, coots, gallinules, and Wilson snipe a day, but not more than 20 Wilson snipe, or 15 of any one species of rails (other than sora) and gallinules a day, 50 in all in 7 days; 4 geese and brant a day, 12 in 7 days, but not more than 25 in all of waterfowl, rails, coots, gallinules, and shore birds a day, and not more than 50 game birds of all kinds in 7 days or in possession. Possession of all game permitted during open season and 10 days thereafter.

Interstate transportation: Export prohibited of all game, except that nonresident licensee may ship game lawfully possessed to his home for own use under affidavit (fee, 25 cents) that it was lawfully killed and will not be bartered or sold; provided that not more than two days' limit of migratory birds may be exported in any one calendar week. Game may be shipped to taxidermist for mounting under affidavit that shipper killed the specimen and that it is not being preserved for sale.

Game taken outside the State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game.

UTAH

Open seasons: [81]	*Dates inclusive*
Deer (buck, with horns not less than 5 inches long)	Oct. 20–Oct. 30.
Bear	Sept. 1–May 1.[82]
Rabbit, hare	No close season.
Duck, goose, brant, coot, Wilson snipe or jacksnipe (see exceptions)	Oct. 1–Dec. 31.
Exceptions: In Beaver Emery, Grand, Iron, Kane, Millard, Morgan, Rich, San Juan, Sevier, Summit, Uintah, Wasatch, and Washington Counties	Oct. 1–Jan. 15.
Duck in Fish Lake Game Preserve	Oct. 1–Nov. 30.
Gallinule	Oct. 1–Nov. 30.

No open season: Does, fawns, elk,[83] antelope, mountain sheep, mountain goats, quail, any species of grouse or sage hens, Hungarian partridge, mourning dove,[84] swans, wood duck, rail, bitterns, sand-hill crane, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: Small game and fish, $10; deer and bear, $15; fish, $3. Resident citizen (male): Game and fish, 12 to 16 years, $1; 16 and over, $3; game, $2; fish, $2; females, 16 and over, $1; guide, $5. Alien: Fish, $7.50. Persons under 16 not permitted to kill deer. Aliens prohibited from hunting in State. Resident citizens, males under 12, and females under 16, not required to obtain licenses to fish. Issued by State fish and game commissioner or deputy, county clerk, or deputy or authorized agent.

Bag limits and possession: One buck a season; 25 ducks, geese, and brant a day, but not including more than 8 geese or brant; 15 Wilson snipe a day. Not more than 25 game birds in all may be taken in one day, but not more than 15 of any one species of gallinules, 50 in all of game birds in possession at any one time.

Interstate transportation: Export of all game prohibited, except under permit and regulations of commissioner.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. Person possessing game during close season in State must show lawful taking.

Sale: Sale of all game prohibited; except that rabbit, bear, and hides of deer legally killed may be sold.

VERMONT

Open seasons:	*Dates inclusive*
Deer (with horns not less than 3 inches long)[85] (see exception)	Nov. 10–Nov. 20.
Exception: In Franklin County	Jan. 1, 1932.
Hare, rabbit	Oct. 1–Feb. 28.
Gray squirrel, ruffed grouse or partridge, woodcock	Oct. 1–Oct. 31.
Quail	Sept. 15–Nov. 30.
Duck, goose, brant, coot	Sept. 16–Dec. 31.
English or Wilson snipe (jacksnipe), gallinule	Sept. 16–Nov. 30.

No open season: Elk, moose, caribou (1932); does, fawns, dove, rail; pheasants, European partridge (1932); swans, wood duck, auks, bitterns, sandhill and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game and fish, $10.50; fish, $3.15; Resident: Game and fish, $1.50; game, $1; fish, $1. Issued by town clerks. Citizen of United States who owns $1,000 taxable property in Vermont pays same fees as resident. Alien resident who has not declared his intention, pays same fees as nonresident; declarant resident for six months in State pays same fees as resident.

Hunting licenses not issued to persons under 16 without written consent of parent or guardian. Owners of farm lands and their resident minor children or tenants may hunt without a license on own lands during open season. Fishing license not required of persons under 15.

Bag limits and possession: One deer a season; 4 each of ruffed grouse and woodcock a day, 25 each a season; 5 hares or rabbits a day or in possession; 4 gray squirrels, 4 quail, 20 ducks, 8 geese, 8 brant a day; 10 Wilson snipe a day; 25 coots, 25 gallinules but not more than 15 gallinules of any one species a day.

Possession of waterfowl, coots, and gallinules permitted during first 10 days of close season.

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[81] *Utah:* Commissioner may shorten or close open season and reduce bag limit on any species of game birds or animals needing additional protection.

[82] Bears destroying livestock may be killed at any time by stock owners or Government trappers.

[83] Elk doing damage may be killed under authority of commissioner.

[84] Commissioner, upon determining that quail, any species of grouse or sage hens, Hungarian partridges, or mourning doves have increased sufficiently, may prescribe an open season and fix bag limits on any such birds.

[85] *Vermont:* Landowner, member of his family, or authorized employee may kill deer doing damage to his fruit trees or crops; but person under whose direction a deer is so killed must, within 12 hours, report the matter in a signed statement to nearest fish and game warden. Deer may also be killed at any time in orchard zones established by commissioner, but such killing must forthwith be reported to owner of orchard and county warden.

Interstate transportation: Export prohibited of all protected game, except hares and rabbits; provided, a nonresident licensee may export one deer under license coupon and one day's bag limit of game birds under permit, but must accompany shipment; resident may export (if not for sale) one day's bag limit of game birds under special permit from commissioner and one deer a season for sale, if it is tagged and license is presented to carrier for cancellation, but laws of State to which deer is shipped must be complied with. Packages containing game delivered to a common carrier for transportation must be tagged to show number and kind of such game therein, names of consignor and consignee, station from which shipped, destination, and number of license. License of shipper must be presented to agent of transportation company for indorsement thereon of quantity of game offered for transportation. Head, hides, feet, and fur of quadrupeds and plumage and skins of game birds legally killed and possessed may be transported without tags if accompanied by owner.

Game taken outside of State and legally exported may be possessed as authorized by permit obtained from fish and game commissioner, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of squirrels and all protected game birds prohibited; deer may be sold during open season and for a "reasonable time thereafter," and hares and rabbits during open season. Head and hide of deer legally taken may be sold.

VIRGINIA

Open seasons:[86]	*Dates inclusive*
Deer (male, with horns visible above the hair) (see exceptions)	Nov. 15–Dec. 31.
Exceptions: In Nansemond County	Oct. 1–Nov. 30.
In Dinwiddie County	Nov. 15–Dec. 31.
In Frederick, King George, Lancaster, Northumberland, Richmond, Rockingham, Stafford, and Westmoreland Counties	No open season.
Elk (see exceptions)	Dec. 15–Dec. 31.[87]
Exceptions: Bull elk only with horns plainly visible above the hair, in Bland, Craig, Giles, Montgomery, and Pulaski Counties (1928)	Nov. 15–Nov. 17.
In national-forest areas	No open season.
Squirrel[88] (see exceptions)	Sept. 1–Jan. 31.
Exceptions: In Buchanan County	Sept. 15–Dec. 31.
In Chesterfield and Spotsylvania Counties	Nov. 15–Jan. 31.
Rabbit, hare,[88] quail or partridge, pheasant or grouse, wild turkey (see exceptions)	Nov. 15–Jan. 31.
Exceptions: Quail in Dinwiddie County	Nov. 15–Jan. 15.
Wild turkey in Spotsylvania County	Nov. 15–Dec. 31.
Ring-necked pheasant in Shenandoah County	Nov. 15–Nov. 25.
In Clarke and Frederick Counties	No open season.
Dove	Sept. 1–Dec. 15.
Woodcock	Nov. 15–Dec. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, mudhen	Nov. 1–Jan. 31.[89]
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Does, fawns, swans, wood duck, eider ducks, reedbirds, auks, bitterns, sand-hill crane, fulmars, gannet, grebes, gulls, herons, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting, trapping, and fishing licenses (combined): Nonresident: $15.50 (additional county certificate, fee $10, required for bull elk in either Bland, Craig, Giles, Montgomery, or Pulaski County); angling, $2.50[90] (not required in tidal waters). Commissioned or enlisted members of Army, Navy, or Marines stationed or located in Virginia pay same fees as residents for hunting licenses. Alien: Game, $15.50 (alien owner of real estate resident for five years, same as resident). Resident: State, $3; county, $1; (county license may be exchanged by holder for State license on payment of $2.20, which includes clerk fee of 10 cents.) Issued by clerks of circuit and corporation courts. Licensee required to wear license button. Certificate in lieu of lost or destroyed license issued under affidavit and on payment of clerk fee of 10 cents on county license and 20 cents on other licenses.

Residents, nonresidents, and aliens and their husbands, wives, or children may hunt, trap, or fish on own premises during open season without license; tenant, renter, or lessee, under written consent of owner or landlord, may hunt, trap, or fish during open season without license on premises on which he resides.

Fishing license not required in tidewater section nor of any person under 16 years of age.

Written consent required to hunt or trap on lands of another. Does not apply to persons hunting foxes or deer with hounds or dogs, where the chase begins on other lands, nor on uninclosed mountain lands west of the Blue Ridge not used for cultivation, except in Bath, Bland, Giles, and Highland Counties.

Special licenses, Back Bay, Princess Anne County: Battery, sinkbox, mat blind,[91] fee $100 (limited to not more than 50 batteries and sinkboxes and 27 mat blinds actually used in 1927–28. Any license not renewed each year may not be reissued until number of batteries and sinkboxes is less than 25 and that of mat blinds less than 11). Shore blind, $50. Issued by clerk, circuit court, Princess Anne County.

Bag limits and possession: One elk a season; 1 deer a day, 2 a season; 10 squirrels a day, 150 a season; 2 turkeys a day, 6 a season; 4 grouse a day, 20 a season; 15 quail a day, 150 a season; 25 doves a day, 250 a season; 4 woodcock a day, 25 a season; 25 ducks a day, 350 a season; 8 geese a day, 50 a season; 8 brant a day, 30 a season, but not more than 35 in all of ducks, geese, and brant a day on Back Bay, Princess Anne County; 20 Wilson snipe a day, 250 a season; 25 sora a day, 500 a season; 25 coots a day, 250 a season; 25 in all of rails (other than sora) and gallinules but not more than 15 of any one species a day, 250 a season. Possession of migratory game birds permitted during open season and 10 days thereafter, and of other game during open season and 5 days thereafter.

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[86] *Virginia:* Commission of Game and Inland Fisheries may by regulation further restrict the time, manner, and means by which game may be taken.

[87] Elk doing damage to private property may be killed at any time under permit of commission of game and inland fisheries.

[88] Residents of State may kill rabbits or hares and squirrels on their own lands at any time.

[89] Wild fowl may not be hunted on Wednesdays, Saturdays, or Sundays, on Back Bay, Princess Anne County.

[90] Residents of States having larger nonresident angling license fee must pay fee charged nonresidents in own State.

[91] Battery, sinkbox, mat blind, or other floating device, or any boat or tender thereof, may not anchor, tie-out, or lie within 700 yards (except in North Bay, 200 yards) of any licensed blind or any blind on shore not licensed that is at any time occupied by the owner, or member or guest of any club owning same, for the purpose of shooting therefrom.

Interstate transportation: Export of all protected game (except rabbits and squirrels) prohibited; provided, during open season any licensee may, under his hunting license, take with him out of State, or as baggage on same conveyance, 1 deer, 50 quail or partridges, 10 pheasants or grouse, 3 wild turkeys, 50 waterfowl, but not exceeding 100 in all, if killed or captured by himself, shipped open to view, and plainly labeled with his name and address; but more than 2 days' limit of geese and brant may not be exported by one person in one calendar week. Any citizen of State may ship from State during open season as a gift and not for sale (which fact must be stated on shipping tag), 1 deer, 18 quail or partridges, 6 pheasants, 3 wild turkeys, and 12 waterfowl, if open to view and plainly labeled with names and addresses of donor and donee and number and kind of each so shipped.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all game prohibited, except of rabbits and squirrels during open season.

WASHINGTON

Open seasons:[92]	*Dates inclusive*
Deer (male), bear, rabbit, squirrel, and upland game birds, open seasons fixed by county game commissions.[92]	
Elk in Benton, Kittitas, Klickitat, and Yakima Counties	Oct. 21–Nov. 1.
Bull elk in Asotin, Columbia, Garfield, and Walla Walla Counties	Oct. 21–Nov. 1.
Duck, goose, brant,[93] coot, Wilson snipe or jacksnipe	Oct. 1–Jan. 1.
Rail, other than coot	Oct. 1–Nov. 30.

No open season:[92] Moose, elk (except as above); does, fawns, antelope, caribou, mountain sheep, mountain goat, and doves; swans, wood duck, eider ducks, auklets, auks, bitterns, little brown and sand-hill cranes, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, band-tailed pigeons, puffins, shearwaters, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen or declarant: State, $25 (applicant from adjoining State pays same fees as charged resident of Washington by State of which he is a resident); game birds, $5; fishing: State, $5; county, $2.50; tourist fishing, State, $3 (valid for 30 days). Resident: State: Game and fish, $7.50; fish, $5; game and fish, county, $1.50; special elk license, $5; (issued to resident only); guide, $10; taxidermist, $5. Issued by county auditors. Alien: Hunting and fishing, State, $10 (issued only to holder of permit to carry firearms); fishing, county, $5. Professional guide (county), $10. Licensee must report number of game, fish, and fur animals taken previous year before renewal of license.

Fishing license not required of persons under 16, if residents.

Bag limits and possession: One deer, 1 elk, a season; 5 each of prairie chickens, sharp-tailed grouse, ruffed grouse, blue grouse, and Chinese or Mongolian pheasants, 10 each of quail and Hungarian partridges, a day or in possession, but if more than one day's limit is desired any number may be possessed if each day's kill is tagged by a warden that day. Twenty ducks, geese, brant, Wilson snipe a week (week ends at midnight Saturday), but not more than 8 geese, 8 brant, a day; 30 ducks, geese, and brant in possession; 25 coots, 25 sora, and 25 in all of other rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession during close season permitted upon filing with county game commission description and number of each kind of game, which must be tagged or stamped by commission for identification, but rails may only be possessed until December 10 and other migratory game birds until January 25.

Interstate transportation: Export of all protected game prohibited, except that nonresident licensee may carry with him one day's limit of game birds upon attaching an affidavit that they were lawfully killed by himself and are not being exported for sale.

Game taken outside of State when accompanied by affidavit of chief game official may be possessed at any time for noncommercial use, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited.

WEST VIRGINIA

Open seasons:[94]	*Dates inclusive*
Deer (male with branched antlers)	Nov. 1–Nov. 10.
Rabbit (except on own land at any time)	Oct. 1–Dec. 31.
Squirrel (except red squirrel, no close season)	Sept. 28–Nov. 30.
Ruffed grouse (pheasant), wild turkey	Oct. 15–Nov. 30.
Quail (Virginia partridge)[95] (see exception)	Nov. 1–Nov. 30.
Exception: In Marshall County	Nov. 1, 1929.
Duck, goose, brant, coot, Wilson snipe or jacksnipe	Nov. 15–Dec. 31.
Woodcock	Nov. 15–Dec. 15.
Rail (ortolan) and gallinule, other than coot	Nov. 15–Nov. 30.

No open season: Elk (1931); does and fawns; dove, imported pheasants, capercailzie, and other introduced foreign game birds; swans, wood duck, bitterns, sand-hill crane, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15; fish, $5; resident, game and fish, $1; issued by county clerk. Aliens not permitted to hunt. License not required of minors under 15. Landowner, his resident children and tenants, may hunt or fish on own land during open season without a license. Unlawful to hunt or fish on lands of another without written permission of owner.

Bag limits and possession: One deer a season; 1 turkey a day, 4 a season; 5 rabbits a day; 8 squirrels a day, 60 a season; 10 quail a day, 60 a season; 4 ruffed grouse a day, 20 a season; 25 ducks, 8 geese, 8 brant, 4 woodcock, 20 Wilson snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; other game legally taken may be possessed at any time.

Interstate transportation: Export prohibited of elk, deer, squirrels, quail, ruffed grouse (pheasant), wild turkeys, geese, brant, ducks. Not more than two days' limit of migratory birds (except waterfowl) may be exported by one person in any one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

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[92] *Washington;* County game commission, with consent of supervisor of game and game fish, may shorten, close, or open season and fix bag limits on game and fur animals and upland game birds, as designated by statute. Communicate with county game commission at county seat, or supervisor of game and game fish, Box 384, Seattle.

[93] No open season on waterfowl on Columbia or Snake Rivers or within a quarter of a mile of their shores in Benton, Columbia, Douglas, Franklin, Garfield, Grant, Kittitas, Klickitat, Walla Walla, Whitman, and Yakima Counties.

[94] *West Virginia:* Commission by order may close season on any game for fixed periods in any county.

[95] Commission may change dates in any county for open season on quail, but may not permit more than 30 days' hunting.

Sale: Sale prohibited of all protected game, except that rabbits may be sold during open season.

Miscellaneous: Unlawful to discharge firearms across any public road, within 400 feet of any schoolhouse or church, within 500 feet of a dwelling house, or on or near any park or place where people gather for pleasure.

WISCONSIN

Open seasons:	*Dates inclusive*
Deer (male, not less than 1 year old), in Pierce, Barron, Chippewa, Rush, Price, Lincoln, Langlade, Oconto and all counties north thereof (season closed in odd, open in even years)	Dec. 1–Dec. 10.
In rest of State	No open season.
Rabbit (except in Crawford County, no close season)	Oct. 1–Feb. 1.
Squirrel (see exception)	Oct. 1–Jan. 1.
Exception: In Dodge, Fond du Lac, Jefferson, Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha Counties	No open season.
Prairie chicken or pinnated grouse, sharp-tailed grouse (see exceptions)	Sept. 15–Sept. 18.
Exceptions: In Barron, Calumet, Columbia, Crawford, Dane, Dunn, Fond du Lac, Grant, Green, Iowa, Jefferson, Kenosha, La Crosse, Lafayette, Lincoln, Manitowoc, Milwaukee, Oneida, Ozaukee, Polk, Racine, Richland, Rock, Sauk, St. Croix, Vernon, Walworth, Washington, Waukesha, Waupaca, and Winnebago Counties	No open season.
In Iron, Marinette, Vilas, and Washburn Counties	Sept. 21, 1929.
Partridge and spruce hen	Oct. 5, 1929.
Woodcock	Oct. 15–Nov. 14.
Duck, coot or mud hen, Wilson snipe or jacksnipe	Sept. 16–Dec. 20.
Goose, brant	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Elk, moose, quail, pheasants [96] (Chinese, English, Mongolian), Hungarian partridge,[96] dove, swans, wood duck, eider ducks, auks, bitterns, little brown, sand-hill and whooping cranes, grebes, guillemots, gulls, herons, loons, murres, terns, and all shore birds (except woodcock and Wilson snipe).

Hunting and fishing licenses: Nonresident; all game, $50; all game (except deer), $25; fish, $3 (3 shipping coupons, $2 additional); fishing license not required of persons under 16; settler, $1 (deer tag, 50 cents); guide, $1. Issued by commission. Resident: Game, $1 (deer tag, 50 cents additional); issued by county clerks.

Hunting licenses not issued to persons under 15 or to aliens. Hunting prohibited in fields of growing grain or on lands of another without consent of owner.

Bag limits and possession: One male deer in even years (1928); 5 squirrels a day (except in Burnett County, no limit), 5 rabbits a day (except in Crawford County, no limit); 5 partridge and spruce hens a day (in 1929); 5 prairie chickens and sharp-tailed grouse a day; 4 woodcock, 8 geese, 8 brant a day. Ducks (including coot or mud hen), 15 a day; snipe, rail, rice hen, gallinule, 15 a day, but not more than 25 in all of rails (other than sora) and gallinules a day.

Possession at any time of deer duly tagged permitted for private use by person killing it.

Possession at any time prohibited of game by person without hunting license or scientist's certificate.

Interstate transportation: Export of all protected game prohibited, except that nonresident licensee may transport, between Dec. 1 and 10, inclusive (1928), 1 deer duly tagged, if he accompanies shipment and may take in his personal possession, openly, a mixed bag of not more than 20 game birds legally killed, but not more than the bag limit for one day of any one variety.

Game taken outside of State and legally exported may be possessed as authorized by permit from conservation commissioner, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited (except rabbit). Rabbits may be sold during open season.

WYOMING

Open seasons:[97]	*Dates inclustre*
Deer (with forked horns) (see exceptions)	Oct. 1–Oct. 15.
Exceptions: In Park County	Sept. 15–Nov. 15.
In Albany and Carbon Counties	Oct. 15–Nov. 30.
In Big Horn, Crook, Niobrara, Washakie, and Weston Counties	Nov. 1–Nov. 30.
In Campbell and Goshen Counties	Oct. 1, 1929.
Elk in Lincoln, Teton, Sublette, Park, and Fremont Counties (except between Roaring Fork Creek and Big Sandy River on the west slope of Wind River Mountains in Bridger National Forest, and north of Big Wind River and south of Sweetwater River in Fremont County)	Sept. 15–Nov. 30.
In Sheridan County	Oct. 1–Oct. 15.
Mountain sheep (mature male with horns not less than one-half curl) in Park County only	Sept. 15–Nov. 15.
Bull moose, buck antelope	Oct. 1–Oct. 31.[98]
Grouse (other than sage grouse) (see exceptions)	Oct. 1–Nov. 15.
Exceptions: In Campbell and Crook Counties	Aug. 15–Sept. 1.
In Albany, Big Horn, Converse, Goshen, Hot Springs, Johnson, Laramie, Natrona, Niobrara, Park, Platte, Uinta, and Washakie Counties	Oct. 1, 1929.
Sage grouse (see exception)	Aug. 1–Aug. 31.
Exception: In Albany, Carbon, Hot Springs, Lincoln, Natrona, Park, Sheridan, Sweetwater, Teton, Uinta, and Weston Counties	Aug. 15–Aug. 31.
Duck, goose, brant coot, gallinule, Wilson snipe	Sept. 16–Dec. 16.

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[96] *Wisconsin*: In towns of Oconomowoc, Summit, Ottawa, and Mukwonago in Waukesha County and in towns of Ixonia, Sullivan, and Concord in Jefferson County, Hungarian partridge may be taken Sept. 4–8, limit, 3 a day; and English pheasant cocks on Mondays only in October—Oct. 1, 8, 15, 22, and 29—limit, 2 cocks a day.

[97] *Wyoming:* State game and fish commission may suspend open season in any county or district of State on any species of game when threatened with extinction.

[98] State game and fish commission may permit bull moose and buck antelope to be killed from Oct. 1 to Oct. 31. Commission may issue not to exceed 100 permits for bull moose and 1,000 for buck antelope. Bull moose: Fees, resident citizen, $50; nonresident or noncitizen, $100; limit, 1 a season. Buck antelope: Fees, resident citizen, $2.50; nonresident or noncitizen, $50; limit, 1 a season.

Open seasons—Continued.	*Dates inclusive*
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Elk (except as above), does and fawns, mountain sheep (except as above), buffalo, quail, Hungarian partridge, Mongolian pheasants prairie chicken (1929); doves, swans, wood duck, bitterns, little brown and sand-hill cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: General, $50 (not issued to minors under 16); nonresident hunting big game must be accompanied by a guide, except that man and wife may accompany one guide; birds, $7.50 (not issued to minors under 16); fish, $3 (not required of minors under 12). Bear, $25 (issued by commissioner; authorizes killing of 3 bears at such times as may be designated). Resident: General, $2.50 (not issued to minors under 16); birds, $1.50 (not issued to minors under 13); fish, $1 (not required of G. A. R. veterans or minors under 12). Guide: Citizen only, $25 (bond, $500; may guide party of 3 nonresidents at one time). Permit to photograph game or birds, under supervision of commission, Jan. 1–Apr. 30, $5. Permit to hunt bear in State game preserves and national forests, $1 and $1 for each dog. Taxidermist, $10. License issued by commissioner, justice of peace, assistant and deputy wardens, and county and city clerks. Unlawful to hunt on inclosed lands of another without consent of owner. Special permits for moose and antelope; see footnote 98, p. 36.

Bag limits and possession: One deer, 1 elk, 1 mountain sheep a season; under special permits,[93] 1 moose, 1 antelope a season; 6 sage hens, sage chickens, or grouse; 8 geese, 15 other game birds a day; possession limited to 15 game birds, of which not more than 6 may be sage hens, sage chickens, or grouse.

Interstate transportation: Export of all protected game prohibited, provided game may be exported if properly tagged by a justice of peace; fee, 50 cents. Game tags issued under affidavit that game was lawfully killed, and, if for edible portion, that it is not for sale. Not more than 50 ducks, 16 geese, 16 brant, 40 Wilson snipe, 50 coots or 50 in all of rails and gallinules but not more than 30 of any one species may be exported by one person in any one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. Person possessing game during close season in State must show lawful taking.

Sale: Sale of all game of State prohibited, provided sale of game (except edible portion) is permitted when properly tagged. Justice of peace issues tags (fee, 50 cents) under affidavit that game was lawfully captured or killed. Sale of migratory birds prohibited.

CANADA

The migratory-birds convention act of August 29, 1917, as amended in 1919, 1921, and 1925, and the regulations thereunder promulgated by the Governor General in council, are similar to the migratory bird treaty act and regulations in that they give effect to and conform with the provisions of the treaty between the United States and Great Britain for the protection of migratory birds in the United States and Canada. Full text of the regulations, as amended, will be found in a publication issued annually by the Commissioner of National Parks of Canada, Ottawa.

Canada also has a general law prohibiting export of deer carcasses or parts thereof (except as to cured deer heads and hides of deer and except carcasses and parts of deer raised on private preserves); and wild turkey, quail, partridge, prairie fowl, and woodcock; but subject to Provincial laws and under a permit from the collector of customs a nonresident licensee, on not more than two occasions during one calendar year, may export, during the open season in the Province where killed and within 15 days thereafter, not more than the whole or parts of 1 moose and 3 deer not being moose, legally shot by him for sport and not for gain or hire; provided, however, that a nonresident licensee may export from Yukon Territory in one year the hides and heads of not more than 2 moose, 4 caribou, and 4 deer not being moose or caribou. Such licensee, at any port of export, may make an export entry in duplicate of such deer or parts thereof upon subscribing before the collector or other officer of customs a declaration to be annexed to said export entry, producing his license or permit for shooting the deer to the collector or other officer of customs, who shall indorse thereon a description of the quantity and parts entered for exportation, and thereupon, if satisfied as to the identity of the sportsman and that the exportation is not prohibited, may issue his permit under the seal of the customhouse for the export of the deer or parts thereof, which permit must accompany the shipment. The ports of export are Halifax and Yarmouth, Nova Scotia; McAdam Junction, St. John, and St. Stephen, New Brunswick; Montreal, Quebec, Sherbrooke, Beebe Junction, and St. Armand, Quebec; Bridgeburg, Brockville, Kingston, Ottawa, Port Arthur, Prescott, Niagara Falls, Sarnia, Sault Ste. Marie, Toronto, and Windsor, Ontario; Emerson, Manitoba; North Portal, Saskatchewan; Coutts, Alberta; Kingsgate and Waneta, British Columbia; Whitehorse, Yukon Territory, and all other customs ports and outports on the frontier of the United States; and such others as the Minister of Customs may designate.

ALBERTA

Open seasons:[99] [1]	*Dates inclusive*
Deer, moose, caribou (must have horns at least 4 inches long)	Nov. 1–Dec. 14.[2]
Mountain sheep (male), mountain goat (must have horns at least 4 inches long)	Sept. 1–Oct. 31.
Bear (except cubs or bear with cub)	Sept. 1–June 14.
European gray partridge (Hungarian partridge)	Oct. 1–Nov. 30.
Duck, goose, Wilson snipe or jacksnipe, coot, gallinule:	
North of Clearwater and Athabaska Rivers	Sept. 1–Dec. 14.
South	Sept. 15–Dec. 14.

No open season: Elk or wapiti, buffalo; females of deer, moose, mountain sheep, young of all big game with horns less than 4 inches in length, antelope; grouse, partridge, prairie chicken, ptarmigan; pheasant, dove, swans, wood duck, rail, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting licenses:[2] Nonresident: General, $50; bird, $5. Resident: Big game, $1; birds, $2.25; not required of farmer or member of family residing with him on farm nor of residents residing north of fifty-fifth parallel; guide, $2.50 (guide may not act for more than three persons on any trip). Special license: Nonresident, $50; resident, $5 (issued to holders of general licenses and authorizes taking of deer, moose, and caribou in Rocky Mountain Forest Reserve of Alberta, Sept. 1 to Oct. 31, inclusive). Taxidermist, $5. Issued by minister of agriculture.

Bag limits and possession: Deer, moose, caribou, mountain sheep, mountain goat, bear, 1 of each species a season; Hungarian partridges, 15 a day, 75 a season; 30 ducks a day, 200 a season; 15 geese, 25 coots, 25 Wilson snipe, a day. Migratory game birds legally taken during the open season may be possessed until Mar. 31.

Export: Export of all protected game prohibited, except that minister of agriculture may grant permits for export of game at rate of $5 for each head of big game and $1 a dozen for game birds. The holder of a general nonresident license may take with him out of Province as trophies, heads, skins, and hoofs of big game legally killed by him. Any person may export mounted or branded heads at a fee of $1 for each head. Export of migratory birds prohibited during close season.

Sale: Sale of migratory game birds and flesh of all other game prohibited. Heads of big game before being sold must be stamped by minister of agriculture at fee of $5 for elk, caribou, moose, mountain sheep, and $2 each for deer and mountain goat.

BRITISH COLUMBIA

Open seasons:[3]	*Dates inclusive*
Bull moose in Atlin, Fort George, and Cariboo electoral districts and north main line Canadian National Railway in Omineca electoral district	Sept. 1–Dec. 15.
In Columbia electoral district (except west of Columbia River)	Oct. 1–Oct. 31.
Bull caribou, in eastern district except in Mackenzie and Skeena electoral districts, Cariboo electoral district west of Fraser River, and except south of main line Canadian Pacific Railway	Sept. 1–Dec. 15.
Bull elk (wapiti) in Fernie and Cranbrook electoral districts and in Columbia electoral district (except west of Columbia River)	Oct. 1–Oct. 15.
Male mountain sheep, in eastern district north of Canadian National Railway and in Cariboo and Lillooet electoral districts south of fifty-second parallel and west of Fraser River	Sept. 1–Nov. 15.
In Fernie, Cranbrook, and Columbia electoral districts	Oct. 1–Oct. 31.
Mountain goat in eastern district (except between Columbia and Fraser Rivers and south of Canadian Pacific Railway from Revelstoke to Ashcroft)	Sept. 1–Nov. 30.
In western district (except Vancouver Island)	Sept. 15–Nov. 30.
Male deer (mule, white-tail, coast) in eastern district (see exception)	Sept. 1–Nov. 30.
Exception: White-tailed deer in North and South Okanagan and Similkameen electoral districts and west of summit of Midway Mountains in Grand Forks-Greenwood electoral district	No open season.
In western district (see exceptions)	Sept. 15–Nov. 30.
Exceptions: In North and South Saanich and Highland districts on Vancouver Island	Sept. 15–Oct. 31.
On Queen Charlotte Islands and Hornby Island	No open season.
Bear (except white or Kermodei bear) in eastern district	Sept. 1–June 30.
In western district	Sept. 15–June 30.
Band-tailed pigeon	Sept. 15–Sept. 30.
Duck, goose, brant, coot, Wilson snipe or jacksnipe: Eastern district[4]	Sept. 15–Dec. 31.
Duck, goose, coot, Wilson snipe or jacksnipe: Western district[4]	Oct. 15–Jan. 31.
Black brant: Western district[4]	Nov. 15–Feb. 28.

No open season: Buffalo, young of mountain goat, and moose, caribou, elk, deer, and sheep, except males over 1 year of age as above; rail, swans, wood duck, little brown and sand-hill cranes, auklets, auks, bitterns, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except Wilson snipe).

Hunting and fishing licenses: Nonresident: General, $25 and $25 additional for each grizzly bear, moose, mountain sheep, wapiti, or caribou, $15 additional for each black or brown bear, mountain goat, or mule deer, and $5 additional for every deer of any other species shot by him; angling, season $10; British subject, birds $5 a week. Resident British subjects or farmers as defined under game act, and members of army, navy, air forces, or militia on duty in Province: Deer and birds, $2.50; big game and birds, $5. Big game, birds, and trapping, $10 (holder must report within 2 months after expiration of license number of big game or fur animals taken); resident alien, $10 (big game and game birds only); guide, $5; taxidermist, $5. Issued by warden or any person authorized by him.

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[99] *Alberta:* Seasons on game birds fixed by lieutenant governor in council and may be obtained from game commissioner, Edmonton.

[1] Resident north of fifty-fifth parallel, when necessary to provide food for his family, may kill big game (other than buffalo and elk) and scoters.

[2] Deer, moose, and caribou (big game must have horns at least 4 inches long), open season under special license in Rocky Mountain Forest Reserves of Alberta, Sept. 1 to Oct. 31, inclusive (see Hunting licenses).

[3] *British Columbia:* Regulations prescribing seasons, bag limits, and restrictions on sale of upland game birds for season 1928–29 are adopted by lieutenant governor in council. Full information may be had from provincial game warden, Victoria, British Columbia.

[4] *Western district* includes that portion of the Province west of summit of Cascades and south of Atlin electoral district, except for migratory birds east of the easterly railway yard limit of Alta Lake Railway Station on Pacific Great Eastern Railway. *Eastern district* includes balance of Province.

No fee required of farmer holding more than 10 acres of land or member of family for license to hunt birds and deer during open season on land on which he resides. Free license granted to resident prospector under certain conditions upon production of free miner's certificate. No license issued to person under 18 without written consent of parent or guardian, and then to hunt with firearms only under supervision of licensed adult. Unlawful to hunt on cultivated, cleared, or inclosed land without owner's consent.

Badge to be worn by licensee. Firearms not to be carried without license.

Bag limits and possession: One moose, 2 caribou (except in eastern district south Canadian National Railway, limit 1), 1 elk (wapiti), 2 mountain sheep (except in Fernie, Cranbrook, Columbia, Cariboo, and Lillooet electoral districts, limit 1), 2 mountain goats, 2 deer in eastern district, 3 in western district, 1 grizzly bear and 3 bears of any other species a season; 10 band-tailed pigeons a day, 50 a season; 20 ducks a day, 150 a season; 10 geese a day, 50 a season; 10 brant a day, 50 a season; 25 Wilson snipe a day, 150 a season; 25 coots a day. (Limits on other species of game fixed by regulations of lieutenant governor in council.) Game may be possessed for 2 weeks after close of open season. Unlawful for a dealer in skins to possess the skin of any wapiti (elk) or deer.

Export: Export prohibited of all game except under permit of provincial game warden.

Sale: Sale of migratory game birds prohibited and of all other game, except under regulations of lieutenant governor in council; provided, bull moose and bull caribou may be sold in Atlin and Omineca electoral districts from Oct. 1 to Dec. 15, and bears (except white or Kermodei bears) in eastern district [4] from Sept. 1 to June 30.

MANITOBA

Open seasons: [5]	*Dates inclusive*
Deer, moose, caribou, or reindeer (males)	Nov. 21–Nov. 30.
Ptarmigan	Oct. 1–Oct. 20.
Duck, goose, coot, Wilson snipe (see exception)	Sept. 15–Nov. 30.
Exception: Duck, north fifty-third parallel	Sept. 1–Nov. 30.

No open season: Bison or buffalo, elk or wapiti, antelope or cabri, females and young of big game; dove, prairie chicken, partridge, ruffed grouse, quail, pheasant, Hungarian partridge, introduced game birds; rail, swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting licenses: Nonresident alien, big game, $25; birds, $25. Nonresident British, big game, $15; birds, $10. Resident, big game, $5; birds, $2. Issued by minister of agriculture. License to hunt deer not issued after November 20. Hunting prohibited on inclosed or cultivated land or land covered by buildings or water, without consent of owner. No license required of farmers or members of family to hunt on farm on which they reside. Holder of resident bird license required, on or before December 15, to return license with sworn statement that he has not violated the act.

Bag limits and possession: One in all of deer, moose, and caribou a season; 15 ptarmigans a day, 50 a season; prairie chickens, partridges, or ruffed grouse, 25 in all a season; 20 ducks a day in September, 40 a day in October and November, 200 a season; 10 geese, 25 coots, and 25 Wilson snipe a day. Possession of ptarmigans, prairie chickens, partridges, and grouse allowed for 10 days after close of hunting season and of migratory game birds until Mar. 31. Venison for private use may be possessed at any time on proof of legal killing. Heads and hides of big game legally taken, within or without Province, may be possessed at any time.

Export: Export prohibited of all protected game except under permit issued by department of agriculture. No permit may be issued for export of ptarmigans, prairie chickens, partridges, grouse, geese, ducks, or entire carcass of any moose, caribou, or deer; provided, nonresident licensee under permit issued free may export carcass of moose, caribou, or deer, and not more than 50 geese and 50 ducks killed by him. (No ducks may be exported before Oct. 1.) Export of migratory birds prohibited during close season.

Sale: Sale of all protected game prohibited except heads and hides of big game.

Miscellaneous: Big-game hunter must wear complete outer suit and cap of white material.

NEW BRUNSWICK

Open seasons:	*Dates inclusive*
Deer (see exception)	Sept. 15–Nov. 30.
Exception: On Grand Manan, Campobello, and Deer Island	No open season.[6]
Bull moose (antlers must have 10 points)	Oct. 1–Nov. 30.
Duck, goose, brant, rail, coot, gallinule (see exception)	Sept. 15–Dec. 31.
Exception: Islands in the Grand Manan group	Oct. 15–Jan. 31.
Woodcock, jacksnipe or Wilson snipe	Oct. 1–Nov. 30.

No open season: Caribou (Oct. 1, 1930); calf moose under 3 years and cow moose; pheasant, partridge, swans, wood duck, auks, bitterns, fulmars, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Big game, $50 (1 bull moose, 2 deer, 2 bears); $25 (2 deer); special license, $25 (2 bears, Apr. 1–June 30); bird, $25; trout, $10; salmon, $25. Resident: Big game; $3 (1 bull moose, 2 deer); $2 (2 deer); taxidermist, $1; guide, $1; camp help, $1. Special license for salmon in reserved waters of the Restigouche: Nonresident, $25 a day; resident, $5 a day. Issued by minister of lands and mines and authorized vendors. Resident big-game licensees must report number of game animals killed thereunder not later than December 5, and return license and unused tags. Big-game license not issued to persons under 18. Nonresident licensee must have registered guide, and not more than two hunters may accompany one guide.

Bag limits and possession: Two deer, 1 moose (lumber camp limited to 2 moose and 4 deer) a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, gallinules, 10 woodcock, and 25 Wilson snipe a day. Game may be kept for personal use in cold storage during close season under permit, but migratory game birds may not be possessed after Jan. 31.

Export: Export of all game prohibited, except game killed by nonresident licensee may be exported, within 15 days after being killed, under permit from Canadian customs office.

Sale: Sale of all game prohibited, except that a licensed hunter may sell moose or deer that he has lawfully killed. Keepers of hotels, inns, etc., may serve game during open season and 15 days thereafter. Hides and skins of animals may be sold under license by nonresidents or aliens, fee, $25; and residents, fee, $5.

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[5] *Manitoba:* Open season may be shortened or closed or bag limits reduced by order-in-council.

[6] *New Brunswick:* Minister of lands and mines may issue license (fee, $1) to resident of Grand Manan, Campobello, or Deer Island to take 1 deer, Oct. 15–Nov. 15.

NORTHWEST TERRITORIES[7]

Open seasons:	*Dates inclusive*
Deer and moose (males only), mountain goat	Sept. 1–Mar. 31.
Mountain sheep, caribou	Aug. 1–Sept. 30. Dec. 1–Mar. 31.
Partridge, prairie chicken, ptarmigan, and other grouse	Sept. 1–Dec. 31.
Duck, goose, brant, rail, coot, gallinule, Wilson snipe	Sept. 1–Dec. 14.

No open season: Buffalo or bison; musk-ox, wapiti or elk, does; females of moose, caribou, mountain sheep, and mountain goat with young, and young of any such animals; swans, wood duck; auks, bitterns, little brown and sand-hill cranes, fulmars, grebes, guillemots, gulls, jaegers, loons, murres, terns, and all shore birds (except Wilson snipe or jacksnipe). Hunting or trapping prohibited on Arctic Islands Preserve, Victoria and Banks Islands and the Peel River, Yellowknife, and Slave River preserves, reserved as hunting and trapping grounds for native Indians, Eskimos, and half-breeds. All hunting prohibited in Thelon Game Sanctuary.

Hunting and trapping licenses: General: Nonresident, $150; nonresident British subject, $75; resident, $2. Trading or trafficking in game: Nonresident, $300; nonresident British subject, $150; resident, $5. Issued by director of Northwest Territories. Permit from commissioner required to establish trading post. Licensee, on or before July 1, must return license to nearest game officer or warden with a statement of number of each kind of game killed, or trafficked in. Native-born Indians, Eskimos, or half-breeds bona fide residents of Northwest Territories may hunt without a license.

Bag limits and possession: Two bull moose, 2 male deer, 4 caribou; mountain sheep, 2 of any species, 3 in all; mountain goat, 2 of any species a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, and 25 Wilson snipe a day. Migratory game birds legally taken during open season may be possessed until Apr. 14.

Export: Export of the meat of any game and the skins of caribou prohibited, except under permit from minister or authorized officer.

Sale: Sale of migratory game birds during close season and of all other game illegally taken prohibited.

NOVA SCOTIA

Open seasons:	*Dates inclusive*
Bull moose (except on Cape Breton Island, no open season), male deer	Oct. 16–Nov. 15.[8]
Hare, rabbit	Nov. 1–Feb. 28.
Duck, goose, brant, rail, coot, gallinule (see exceptions)	Sept. 15–Dec. 31.
Exceptions: Goose, brant, in Shelburne and Queens Counties (only persons holding license from minister)	Nov. 1–Feb. 14.
Duck, rail, in Yarmouth, Digby, Queens, and Shelburne Counties, and in Cape Breton Island	Oct. 15–Jan. 31.
Woodcock, Wilson snipe or jacksnipe	Oct. 1–Nov. 30.

No open season: Caribou, females and young of deer and moose; Canada grouse (spruce partridge) ruffed grouse (birch partridge), Hungarian partridge, pheasant; swans, wood duck, auks; bitterns, fulmars, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting licenses: Nonresident or alien: All game, $50; birds and small game, except woodcock and snipe, $15. Resident: Big game, $2, guide, $2. Taxidermist, $5. Issued by minister of lands and forests and agents. Licenses not issued to persons under 18 years of age.

Bag limits and possession: One deer, 1 moose a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, 10 woodcock, and 25 Wilson snipe a day. The green hide or fresh meat of moose and deer may be possessed Oct. 16 to Nov. 20, and migratory game birds legally taken during open season may be possessed until the last day of February.

Export: Export prohibited of all protected game, except that holder of nonresident general license may ship out of Province under license tag 1 moose lawfully shot by himself. Hares or rabbits lawfully killed may be exported at any time.

Sale: Sale of deer, moose, caribou, pheasant, blackcock, capercailzie, Canada grouse (spruce partridge), chukar partridge, ruffed grouse, Hungarian partridge, and all migratory game birds, prohibited. Rabbits may be sold Nov. 1 to Mar. 1.

ONTARIO

Open seasons:[9]	*Dates inclusive*
Deer, bull moose, caribou, north of main line Canadian National Railway, between Quebec and Manitoba boundary lines	Sept. 15–Nov. 25.
South of Canadian National Railway to Mattawa River and Canadian Pacific Railway to Heron Bay, north shore Lake Superior	Oct. 20–Nov. 25.
South Canadian Pacific and Heron Bay and north Lake Nipissing and French River (see exception)	Nov. 1–Nov. 25.
Exception: On St. Joseph Island, Algoma district	Nov. 10–Nov. 25.
South of French and Mattawa Rivers	Nov. 5–Nov. 20.
Hare	No close season.
Woodcock	Sept. 15–Nov. 30.
Wilson snipe or jacksnipe	Sept. 1–Dec. 15.
Duck, goose, brant, rail, coot, gallinule:	
North and west of French and Mattawa Rivers and in all Georgian Bay waters (see exception)	Sept. 1–Dec. 15.[10]
Exception: Eider duck, north of Quebec, Cochrane, Winnipeg line of Canadian National Railway, only	Sept. 1–Dec. 15.
South of French and Mattawa Rivers, but not including Georgian Bay waters	Sept. 15–Dec. 15.[10]

No open season: Cow and calf moose and young of moose and caribou under 1 year of age; black or gray squirrels, quail, ruffed grouse or partridge, pheasant or prairie fowl, wild turkey; dove, swans, wood duck,[10] eider duck (except as above), auks, bitterns; little brown, sand-hill, and whooping cranes; gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson snipe).

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[7] "*Northwest Territories* means the northwest territories formerly known as Rupert's Land and the northwestern territory (except such portions thereof as are included in the Provinces of Ontario, Quebec, Manitoba, Saskatchewan, and Alberta and the Yukon Territory), together with all British territories and possessions in North America and all islands adjacent thereto not included within any Province, except the colony of Newfoundland and its dependencies."

[8] *Nova Scotia:* Every person killing a deer or moose must, within 10 days, make a written and signed report to minister showing his address, when and where such animal was killed, and its sex.

[9] *Ontario:* Lieutenant governor in council may alter current close season on any game animal or game bird diminished in numbers.

[10] Lieutenant governor in council may permit the taking of wood ducks under special regulations.

Hunting licenses: Nonresident: General, $41; game birds and rabbits, $21. Resident, moose and caribou, $6; deer, $4; camp license, $4 (allows 1 deer to 6 residents for food in camp). Guide, $2. Issued by department of game and fisheries.

Bag limits and possession: One deer, 1 bull moose, 1 caribou a season; 25 ducks a day, 200 a season; 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, 10 woodcock, and 25 Wilson snipe a day. Two or more persons hunting together under license may kill an average of 1 deer each. Possession of all game legally taken permitted during open season and until Mar. 31.

Export: The export of all wild game animals and birds is prohibited; provided, 1 deer, 100 ducks, either 1 bull moose, reindeer, or caribou, and under export permit bears or bear pelts, may be exported under nonresident hunting license if shipping coupon and, if required, affidavit of lawful killing be attached and contents of packages be open to view. Minister may issue permit for export of game, dead or alive, at any time, except migratory birds, during close season.

Sale: Sale or purchase of deer, moose, caribou, migratory game birds, quail, grouse, introduced pheasants, and Hungarian partridges prohibited

PRINCE EDWARD ISLAND

Open seasons:	*Dates inclusive*
Hare, rabbit	Nov. 1–Feb. 1.
Partridge (open in odd, closed in even years)	Oct. 15, 1929.
Duck, goose, brant, rail, coot, gallinule	Sept. 1–Dec. 14.
Woodcock, jacksnipe or Wilson snipe	Sept. 15–Nov. 30.

No open season: Pheasant, swans, wood duck, bitterns, little brown crane, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe or jacksnipe).

Hunting and fishing licenses: Nonresident, Game: Fee, $5; sons, brothers, and sisters of residents returning for visit, $2.50; guest permit fee, $2.25 per week. Issued by game inspector or justice of the peace. Hunting on inclosed lands without permission of owner prohibited.

Nonresident, angling fee, $2 (not required of son, daughter, sister, or brother of a permanent resident of Province). Issued by Provincial treasurer or game inspector.

Bag limits and possession: Three partridges a day (in 1929); 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, 10 woodcock, and 25 Wilson snipe a day. Migratory game birds legally taken in open season may be possessed until January 31.

Export: Export prohibited of all game, provided, nonresident licensee may carry out of Province 12 birds killed by himself if tagged and carried open to view. Export of migratory birds prohibited during close season.

Sale: Game lawfully killed (except migratory birds) may be sold during open season.

QUEBEC

Open seasons:	*Dates inclusive*
Moose (see exception)	Sept. 10–Dec. 31.
Exception: South of St. Lawrence River	Sept. 20–Dec. 31.
Deer	Sept. 1–Nov. 30.
Hare	Oct. 15–Jan. 31.
Bear	Aug. 20–June 30.
Birch or swamp partridge	Sept. 1–Dec. 14.
White partridge or ptarmigan	Nov. 1–Jan. 31.
Duck, goose, brant, rail, coot, gallinule, woodcock, jacksnipe or Wilson snipe	Sept. 1–Dec. 15.

No open season: Caribou, cow moose, young of deer and moose, swans, wood duck, eider ducks (except north of Quebec, Cochrane, Winnipeg line, Canadian National Railway), auks, bitterns, fulmars, gannet, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson snipe).

Hunting licenses: Nonresident: General, $25 (members of incorporated hunting clubs, $10). Resident, $2 (not required of resident British subject hunting for own use). Issued by minister of colonization.

Bag limits and possession: Two deer, 1 moose, a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, 10 woodcock, and 25 Wilson snipe a day. Migratory game birds legally taken during open season may be possessed until March 31, and others during first 15 days of close season.

Export: Export of moose and deer, or parts thereof, prohibited, except nonresident licensee may take out game animals killed by himself, under customs declaration and approval of Canadian collector of customs; export of migratory birds prohibited during close season. Big game lawfully taken and coming from without Province may be transported under permit issued by minister of colonization.

Sale: Sale of deer and moose or any part thereof, and of all migratory game birds (except ducks during the open season) prohibited; also spruce partridge until October 15, 1930. Other game lawfully taken may be sold from the third day of open season to and including the fifteenth day after expiration of open season. Licensed hotels, restaurants, and clubs may serve game lawfully taken, except birch or spruce partridge.

SASKATCHEWAN

Open seasons: [11]	*Dates inclusive*
Deer, moose (males only), caribou (see exception)	Nov. 15–Dec. 14.
Exception: South of Township 35	No open season.
Hungarian partridge	Oct. 1–Oct. 31.
Duck, goose, coot, Wilson snipe or jacksnipe	Sept. 15–Dec. 31.

No open season: Antelope, buffalo, elk, and females of big game other than caribou, and young of big game under 1 year of age.[12] Sage grouse, prairie chicken, pinnated grouse, sharp-tailed grouse, ruffed grouse, partridge, Canada grouse, spruce grouse, ptarmigan, rail, swans, wood duck, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).

Hunting licenses: Nonresident alien: Big game, $50; birds, $25; nonresident domiciled in Canada: Big game, $25; birds, $10; issued by minister of agriculture. Resident: Big game, $5; birds, $1.50; issued by minister or agent. Bird license not required of residents hunting on land outside city, town, village, or hamlet on which they are actually domiciled. No license issued to person under 16 without written consent of parent or guardian. Big-game hunters must wear white suit and cap. Hunting prohibited on inclosed lands without consent. Taxidermist, $5.

Bag limits and possession: One moose, 2 deer, 2 caribou, but not more than 2 in all of big game animals a season; 10 Hungarian partridge a day, 30 a season; 10 geese, 30 in all of waterfowl a day; 30 geese, 200 in all of waterfowl a season; 25 coots a day, 150 a season; 15 Wilson snipe a day, 150 a season. Game birds may be kept in licensed storage from Sept. 16 to Mar. 1 and flesh of big game from Dec. 1 to Apr. 1 if tagged with number and kind of game, name of depositor, and number of his hunting license. Licensed hunters must report number of big game and game birds killed.

Export: Export of all protected game prohibited; provided, nonresident licensee on leaving Province may take with him during open season personally under his license coupons and permit big game and 100 game birds legally killed. Export of migratory birds prohibited during close season. Minister may issue permits to export deer (fee $2 a head) or other big game (fee, $5 a head), hides of big game (fee, $1 each), flesh of big game (fee, $1 each 20 pounds or less); birds (fee, $1 a dozen; limits, 5 dozen waterfowl a season). No permit may be issued for the entire carcass of a

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[11] *Saskatchewan:* Lieutenant governor in council may extend close seasons over current year, within limits, on petition of six game guardians.

[12] Male moose having horns less than 6 inches in length deemed to be under 1 year of age.

moose, caribou, or other deer, and no person may export in one season more than 60 ducks or geese.
Sale: Sale of migratory game birds and flesh of all other protected game prohibited.

YUKON

Open seasons: [13]	*Dates inclusive*
Deer, moose, caribou, mountain sheep, mountain goat (males only)	Aug. 1–Mar. 1.
Partridge, prairie chicken, grouse, ptarmigan, pheasant	Sept. 1–Mar. 15.
Duck, goose, brant, rail, coot, gallinule, Wilson snipe or jacksnipe	Sept. 1–Dec. 14.

No open season: Elk or wapiti, musk-ox, bison or buffalo, and females of other big game; swans, cranes, grebes, gulls, jaegers, loons, terns, and all shore birds (except Wilson snipe or jacksnipe).
Hunting licenses: Nonresident, $100 (permits the killing of 1 moose, 2 deer, 2 caribou, 1 mountain sheep, and 1 mountain goat); licensee in addition may kill 1 moose, 2 deer, 2 caribou, 1 mountain sheep, and 1 mountain goat, but must pay a fee of $25 for each additional animal so taken. Resident, $25 (special license authorizing the killing of male moose and male caribou over 1 year of age at any time for food supplies in the Territory); licensee must make annual returns. Resident: Chief guide, $20; assistant guide, $10. Issued by commissioner or game guardian.
Bag limits and possession: (For limits on big game to a nonresident, see "Hunting licenses.") Six caribou, 6 deer, 2 moose, 2 mountain sheep, 2 mountain goats, 6 bears, a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, and 25 Wilson snipe a day. Migratory game birds legally taken during open season may be possessed until Apr. 14.
Export: Export of migratory birds prohibited during close season. Upon affidavit of lawful killing, commissioner may issue permit to export game. Export of raw hide of moose or caribou prohibited except under permit. Trophies, including head, hide, and hoofs, of big game lawfully killed by nonresident may be exported under his license and certificate of game guardian.
Sale: Deer, moose, caribou, mountain sheep, and mountain goats lawfully taken may be sold during the open season and 60 days thereafter. Male moose and male caribou more than 1 year of age killed by a resident under special license may be sold at any time for food upon obtaining certificate of lawful killing from a game guardian. License (fee, $10) required to purchase and traffic in flesh of moose or caribou. Licensee must make annual returns. Sale of migratory birds prohibited during close season.

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[13] *Yukon:* Indians, explorers, surveyors, prospectors, miners, and travelers in need of food may take game during close season. Commissioner in council may alter seasons.

COLONY OF NEWFOUNDLAND

Open seasons:	*Dates inclusive*
Hare, rabbit	Sept. 20–Jan. 1.[14]
Ptarmigan, willow grouse or partridge, plovers, curlew, snipe, or "other wild or migratory birds (except wild geese and crows, unprotected)"	Sept. 20–Jan. 1.

No open season: Elk, moose, caribou, capercailzie or black game.
Fishing licenses: Nonresident: Fish (salmon and sea trout), $10.50. Guide, nonresident, $50; resident free. Issued by game and inland fisheries board.

Unlicensed guides not to be employed. Guide may not conduct party of more than three.
Export: Export for sale prohibited of partridge, willow or other grouse.
Sale: Ptarmigan and willow grouse taken in open season and in possession of seller on Jan. 1, may be sold until Jan. 15; other birds may be sold during open season.

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[14] *Newfoundland*: Hare or rabbit may also be taken with trap or snare until Mar. 1.

MEXICO

Open seasons: [15]	*Dates inclusive*
Upland plover	Sept. 1–Sept. 30.
Wilson snipe or jacksnipe	Nov. 1–Feb. 28.
Other shorebirds	Aug. 16–Sept. 30.
Duck, goose, swan	Oct. 1–Feb. 28.
White-winged dove	Sept. 16–Nov. 15.
Pigeons and other doves	Oct. 1–Dec. 31.
Wild turkey, curassow, cojolite	Sept. 1–Dec. 31.
Rabbit	Oct. 1–Feb. 28.
Deer, male, northern region, central tablelands (and similar places more than 1,000 meters above sea level)	Oct. 16–Jan. 31.
Deer, male, northwest region (Lower California, Sonora, and Sinaloa)	Sept. 16–Dec. 31.
Deer, male, south of Tropic of Cancer	July 1–Sept. 30.
Bear	Sept. 1–Oct. 31.

Open seasons—Continued	*Dates inclusive*
Peccary	Aug. 1–Feb. 28.
Alligator	Feb. 1–Sept. 30.
Anteater, kinkajou	Oct. 1–Jan. 31.
Paca, armadillo	Nov. 1–Jan. 31.
Tapir	Sept. 1–Nov. 30.

No open season: Antelope, mountain sheep (1932). White heron (1931). Mule deer on Cerros Island (1933). Gulls, insectivorous and song birds, manatee, and the young and females of all animals.
Licenses:[15] Hunting for sport: Nonresident alien: Country, $50; State, $25 (good for 30 days). Resident citizen or resident alien: Country, $20 ($10 license good for 6 months); State, $10; municipality, $5 ($1 license good for 10 days). Licenses and permits also required for professional and commercial hunting and for the utilization of game products.
Export: Export of live game birds or animals prohibited except under special permit to a limited number of concessionaires. Fees vary for different species.

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[15] *Mexico*: Secretaria de Agricultura y Fomento, City of Mexico, has authority to established seasons and issue licenses.

IMPORTED GAME AND GAME RAISED IN CAPTIVITY

Regulations adopted pursuant to the provisions of the Federal migratory bird treaty act and the Canadian migratory-birds convention act, which give effect to the migratory-bird treaty in the United States and Canada, respectively, are designed to permit and encourage the propagation and sale of migratory waterfowl. Many States now have laws in practical conformity with the Federal regulations on waterfowl and also permit other species of game to be raised in captivity and sold under permit. The business of game farming when properly conducted has proved profitable, and the demand for game raised in captivity has been greatly increased, for the reason that the sale of migratory birds is prohibited throughout the United States and most of Canada under Federal and Dominion laws, and the sale of practically all species of game is prohibited under State laws.

The Department of Agriculture, acting in conjunction with State game officials and sportsmen, aids so far as possible in establishing the game-breeding industry by preparing drafts of suitable laws to be enacted by the States, issuing permits to breeders to obtain wild migratory waterfowl and their eggs, and otherwise advising where stock may be obtained. The department does not distribute breeding stock or eggs, but in proper cases and under suitable restrictions permits may be issued to assist legitimate enterprises in the conduct of the business of game farming.

The possession, sale, and transportation of imported game and game raised in captivity is also regulated in most States by State laws, which are covered in the following summary:

Federal regulations:[16] Under permit from the Secretary of Agriculture, and subject to the provisions of State laws, live migratory waterfowl raised in capitivity may be possessed, sold, and transported at any time for propagation, and such birds may be killed in any manner (except that they may be killed by shooting only during the open season for waterfowl in the State where killed) and the carcasses with heads and feet attached may be sold and transported at any time to any person for actual consumption, or to the keeper of a hotel, restaurant, or boarding house, retail dealer in meat or game, or a club, for sale or service to their patrons, who may possess such carcasses for actual consumption without a Federal permit; provided that no migratory waterfowl killed by shooting shall be bought or sold unless each bird before attaining the age of 4 weeks shall have had removed from the web of one foot a portion thereof in the form of a **V** for identification purposes.

Permits also are issued under proper restrictions for the capture of a reasonable number of wild migratory waterfowl and the taking of their eggs to enable persons desiring to engage in the business to acquire the nucleus of a breeding stock or to improve the strain of birds on hand, but such wild birds may be sold and possessed only for propagation and may not be killed or sold for food.

Alabama: Commissioner of game and fisheries may issue a permit (fee, $1) to capture or export not more than 10 pairs of each species of game or birds for propagating purposes.

Alaska: Under permit from Secretary of Agriculture wild animals, ducks, geese, and nonmigratory birds may be taken, possessed, and transported for propagation.

Arizona: State game warden may issue permit to take, export, or import game or birds for propagating purposes; and may also issue permit to retain in captivity not more than four abandoned young of big game which applicant has rescued.

Arkansas: Permit (fee, $2) required to propagate game in captivity.

California: Game raised in captivity under breeder's license (fee, $2.50) may be sold for breeding purposes, and under regulations of commission may be sold for food if tagged (fee, 3 cents a tag). All game raised in captivity (except deer) must be killed otherwise than by shooting. Permits may also be issued to capture, possess, or transport wild game animals and game birds for propagating purposes. Shipments by parcel post are prohibited. Pheasants and domesticated reindeer may be imported and sold under regulations of commission.

Colorado: Game raised in licensed private parks, if accompanied by an invoice, and game (except migratory birds other than migratory waterfowl raised in captivity in conformity with Federal regulations—No. 8) brought into State by licensed importer, if shipping invoice is indorsed to purchaser, may be sold and transported. Commissioner may issue permit to capture or import game for propagating purposes.

Connecticut: Game birds and quadrupeds raised in preserve under license (fee, $2) may be sold and transported, if tagged, under regulations of commissioners of fisheries and game. Game legally taken and transported from another State or country that does not prohibit its sale or export may be sold under regulations of the board. Permit required to import game protected in the State.

Delaware: Pheasants and Hungarian partridges may be possessed and sold for propagating purposes. Board, by permit (fee, $1), may authorize any person to capture, possess, and transport not more than 10 pairs of each species of game or birds for propagating purposes.

District of Columbia: Hungarian partridges, English, Mongolian, Chinese, and ring-necked pheasants, and migratory waterfowl raised in captivity, in conformity with Federal regulations, may be possessed, sold, and transported.

Florida: Game and birds may be taken for propagation under permit of State game commissioner.

Georgia: Registered breeder may possess, buy, sell, and transport game for propagation.

Idaho: Permit of State game warden required to take or keep waterfowl in captivity for decoy purposes. Under regulations of the State game warden, game may be propagated in private parks.

Illinois: Game raised in captivity under a breeder's license (fee, $5), may be possessed, sold, and transported for food or propagating purposes.

Indiana: Birds and animals raised in captivity may be kept, killed, sold, or transported under certificate of inspection (fee, $5) from the conservation commission, and game birds legally acquired may be possessed for breeding purposes under like certificates.

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[16] See Federal regulation 8 for full details and requirements (footnote 3, p. 7).

Iowa: Game birds raised in captivity under license (fee, $2) may be sold for food or propagating purposes.

Kansas: Game raised in captivity under permit (fee, $2) may be sold and transported, and under permit and regulations of warden wild animals and birds and the eggs of birds may be taken for propagating purposes.

Kentucky: Game birds and game animals raised in captivity under permit may be sold and transported, but all carcasses must be tagged.

Louisiana: Game raised in captivity under license (fee, $10), may be sold and transported for food, stocking, or breeding purposes, but all carcasses must be tagged. Traffic prohibited in birds killed by shooting. Wild birds or mammals may be brought into State for liberation, and game may be exported for educational, scientific, or propagating purposes, under permit from commissioner.

Maine: Game raised in captivity under breeder's license (fee, $2) may be killed, sold, and transported, and live game may be captured or exported for breeding and advertising purposes, under regulations and permit of commissioner.

Maryland: Game raised in captivity under breeder's license (fee, $5) may be sold and transported under permit of State warden. Such game must be offered to State warden before being offered for sale elsewhere. Chinese, English, Mongolian, or ring-necked pheasants raised in captivity may be killed by shooting or otherwise from November 10 to December 31 on premises where raised.

Massachusetts: Under regulations of division of fisheries and game, deer, elk, pheasants, quail, and European or gray partridges raised in captivity under license (no fee), may be sold for propagation, and killed and sold for food purposes, if tagged; and licensed dealers may sell unplucked bodies of pheasant, Scotch grouse, European black game, European or gray partridge, red-legged partridge, and Egyptian or migratory quail imported from without the United States, if tagged, and deer, moose, caribou, and elk lawfully killed and coming from without State, if tagged by warden of State or country where procured. State tag fees, 5 cents each. Hares and rabbits may be sold during the open season if secured and imported from a country where their sale is not prohibited. Waterfowl may be reared in captivity and sold under Federal regulations (No. 8).[17]

Michigan: Deer, elk, pheasants, and wild ducks raised in captivity under license (fee, $5) may be sold and transported for food, breeding, or stocking purposes. Carcasses of such game must be tagged (tags, 5 cents each). Ducks killed by shooting[17] (except under direct supervision of a deputy warden) may not be sold or disposed of. Licensed dealers may sell unplucked carcasses of pheasants of all species, Scotch grouse, European black game, red-legged partridge, Egyptian quail, European red deer, fallow deer, roebuck, and reindeer lawfully imported from another State or country if tagged on arrival in State. Licensed retail dealer, club, hotel, restaurant, or boarding house may sell portion of said imported game or game raised in captivity, if tagged, to patron or customer for actual consumption or use.

Minnesota: Game raised in captivity under license (fee, $3) may be sold alive for propagating purposes, and may be killed, sold, and transported under regulations of commissioner. Under regulations of the commissioner, wild animals and birds and the eggs of birds may be taken for propagation.

Mississippi: Licensed owner or operator of a game preserve may buy, sell, or transport within or out of the State for propagating purposes game raised on such preserve, but no game may be shipped out of the State except during the open season thereon.

Missouri: Deer, elk, and other protected game raised in captivity under license (fee, $5) may be transported and sold under regulations of commissioner. Export (except of quail) for propagating purposes allowed under permit.

Montana: Game raised in private preserves under license (fee, $5) may be killed, sold, and transported. Commission may authorize capture under permit of wild animals and birds for propagation.

Nebraska: Game animals and birds raised in captivity under license (fee, $1) may be sold for propagation, and killed and sold for food purposes if tagged. Keeper of hotel, boarding house, restaurant, club, or retail dealer in meats under license (fee, $5) may sell tagged game to patron or customer for actual consumption, but tags must remain on carcasses until consumed.

Nevada: Game raised under license (fee, $10) may be sold or shipped under invoice.

New Hampshire: Game raised in captivity under license (fee, $2) may be sold and transported, if tagged, under regulations of commissioner. Game (except ruffed grouse) imported from without the United States, if tagged and marked to show kind and number, name and address of consignor and consignee, initial point of billing, and destination, may be exported unaccompanied by owner.

New Jersey: Mallard, wood, and black ducks, Canada geese,[17] English and Mongolian pheasants, quail, ruffed grouse, deer, rabbits, raccoons, and squirrels raised in preserves under license (fee, $5) may be possessed and sold for propagation, and may be sold for food or exported for sale if tagged (tag fee, 5 cents). The unplucked carcasses of Scotch grouse, European black grouse, European black plover, red-legged partridge, and Egyptian quail coming from a foreign country, if tagged by State authorities, may be sold for food purposes.

New Mexico: Game may be raised in licensed preserve. State warden may issue permit (fee, $1.25) to retain in captivity not more than 4 abandoned young of big game that applicant has rescued. Holder of a hunting license, under permit from State warden, may capture and export game or birds for propagating purposes. Game (except migratory birds other than waterfowl raised in captivity in conformity with Federal regulations [17]) coming from without State may be possessed and sold by a hotel, restaurant, cafe, boarding house, or dealer under a permit good for not more than 30 days.

New York: Elk, mule deer, white-tailed deer, European red deer, fallow deer, Japanese deer, roebuck, pheasants, bobwhite, quail, Hungarian or gray-legged partridges, Canada and Hutchins geese, and mallard and black ducks raised in captivity under license may be sold for breeding purposes; carcasses of quail or Hungarian or gray-legged partridges may not be sold for food nor may those killed by shooting be bought, sold, or trafficked in, but all other species mentioned may be killed, shipped, and sold or exported for food, if tagged. Such ducks and geese may be killed by shooting during the open season, but when so killed may not be sold unless marked and tagged as required by commission.[17] Varying hares and cottontail rabbits raised in captivity under license (fee, $5) if tagged, may be sold for food purposes during close season, under regulations of commission.

Licensed breeders in States having laws similar to the game-breeding law of New York may, under license (fee, $5) and cost of inspection, ship into State domesticated American elk, white-tailed deer, European red deer, fallow deer, roebuck, pheasants, Canada and Hutchins geese, and mallard and black ducks, which, if tagged, may be sold under regulations of commission.

License to possess and sell birds and quadrupeds for propagation, scientific, educational, or exhibition purposes, fee, $1.

The unplucked carcasses of tinamou, pheasants, Scotch grouse, European gray-legged partridge, Norwegian ptarmigan, Norwegian grouse, and Egyptian quail, and species or subspecies not native to State, and carcasses of European red deer, fallow deer, and roebuck imported from without the United States may be sold under license if tagged. No restrictions on reindeer.

North Carolina: Game may be raised in domestication under regulations of department of conservation and development, and may be taken for propagation under permit (fee, $1).

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[17] See Federal regulation 8 for full details and requirements (footnote 3, p. 7).

North Dakota: Game may be kept in captivity under permit of board.

Ohio: Ring-necked, Mongolian, or Chinese pheasants and mallard and black ducks raised in captivity under a breeder's license (fee, $5) may be sold and transported for food or propagating purposes; carcasses of such birds must be tagged. No pheasant, mallard, or black duck raised in captivity may be killed by shooting except during the open season, and no mallard or black duck killed by shooting may be bought or sold unless it shall have had a well-defined V-shaped section removed from the web of one foot before attaining the age of four weeks.

Deer, squirrels, and rabbits legally taken or acquired may be possessed in inclosures as pets.

Oklahoma: Game raised under license (fee, $2) may be sold and transported for propagation and for food, if tagged, during season prescribed by commission. Wild animals or birds may not be taken in State for breeding purposes.

Oregon: Game birds and animals raised in captivity under permit (fee, $2) may be exported or sold for propagating, restocking, or food purposes; carcasses must be tagged (fee, 5 cents). Written permit from State warden, showing kind of game and names and addresses of consignor and consignee, must be attached to each shipment.

Game animals and birds coming from without the United States and game taken in a State where it may be sold, may be sold and transported under permit and tag of State warden, but the only migratory birds that may be sold are waterfowl reared in captivity under Federal[17] or Canadian regulations.

Pennsylvania: Game breeder's certificate required, fee, $1; bond, $500. Game raised in captivity may be sold or transported within State; or, under permit, out of State.

Rhode Island: Game raised in captivity under permit may be sold for propagation, under regulations of commissioners. Game lawfully killed and exported may be brought into State under permit, but such game may not be sold.

South Carolina: Birds and animals legally taken may be kept in possession for propagating purposes. The Federal regulations have been adopted as the State law with respect to migratory birds.[17]

South Dakota: Game raised in captivity under license may be exported or sold under written permission of State game warden.

Tennessee: Under permit (fee, $1) of State warden 10 pairs of game animals or birds may be taken for propagation.

Texas: Game animals and birds may be captured or imported for propagating purposes under permit of commissioner.

Utah: Game raised in private preserve under permit (no fee) of commissioner may be sold and transported, if tagged.

Vermont: Game raised in licensed private preserve (fee, $2) may be sold or exported for food or propagating purposes. Carcasses must be tagged.

Virginia: Game animals and birds raised under breeder's license (fee, $25) may be disposed of for propagating or other purposes. Carcasses of game raised in captivity must be tagged (fees, wild turkeys, 10 cents; deer, bear, or elk, 50 cents; other birds and animals, 2 cents each). Proprietor of hotel or restaurant or dealer in game under a license (fee, $5) may sell to guests or patrons deer, wild turkeys, quail, ruffed grouse, and waterfowl raised in captivity and may sell domesticated rabbits without a license.

Licensed game breeder, under permit and regulations of commission, may trap wild animals or birds for breeding purposes, but animals or birds so taken shall not be sold or otherwise disposed of. Game breeder's license issued only to residents of State.

Washington: Game animals and birds raised in captivity under license (fee, $20, renewal, $10 annually) may be sold and transported at any time, or sold for food, if tagged. Keeper of hotel, restaurant, boarding house, or club, and retail dealer in meats may sell game raised under game farmer's license, if tagged. Under permit from supervisor of game and game fish wild animals and birds may be imported from without State for propagating purposes.

Game animals and birds coming from without State, if reported within 3 days and tagged (fee, 25 cents a tag), may be possessed for tanning, mounting, manufacturing, or ornamental purposes and disposed of in usual course of trade, but the only migratory birds that may be sold are waterfowl reared in domestication under Federal and Canadian regulations.[17]

West Virginia: The owner may kill elk or deer kept in inclosure and may pursue and recapture, by killing or otherwise, elk that have escaped from his inclosure.

Wisconsin: Under permit and supervision of commission wild animals and birds may be taken and transported for propagation within State. Park boards allowed to ship, under permit of State conservation commissioner, live animals and game birds for park purposes.

Wyoming: Under permit (fee, $5) and supervision of commission, game animals may be taken for propagation. Animals so taken may not be killed, sold, or disposed of for three years, but their natural increase may be sold, transported, and disposed of. Exchange of game animals and birds for liberation in State allowed under permit of State game commission.

Canadian Regulations:[18] The Canadian regulations, administered by the commissioner of national parks of Canada, Ottawa, are similar to the provisions of the Federal regulations in respect to the propagation of migratory waterfowl, but apply to all migratory birds protected by the treaty; and all birds raised in captivity and intended for food purposes must be killed otherwise than by shooting, and each of such birds before it can be sold must bear a metal tag, which may not be removed from carcass. Under section 5 of the Canadian customs export act (R. S. C., 1906, ch. 50) a person may export carcass or parts thereof of a deer raised on his own land or on lands owned by a company or association of which he is a member, upon his making affidavit on face of export entry that the carcass, or parts thereof, is of a deer so raised.

Alberta: Minister of agriculture may authorize persons to possess, buy, sell, and export big game and game birds raised in captivity, and to capture big game and game birds for propagation. Permit fees fixed by lieutenant governor in council.

British Columbia: Provincial game warden may authorize persons to possess, buy, sell, and export game animals and game birds raised in captivity, and to capture game animals and birds and collect eggs of birds for propagation. Permit required to import live animals or birds into the Province; permit fees fixed by lieutenant governor in council.

New Brunswick: Minister of lands and mines may authorize persons to possess, buy, sell, and export game raised in captivity, and to capture game for propagation. Permit fees fixed by minister.

Northwest Territories: Minister of the interior may authorize persons to possess, buy, sell, and export wild mammals and birds raised in captivity, and to capture wild mammals and birds and collect eggs of birds for propagation.

Nova Scotia: Minister may authorize persons to possess, buy, sell, and export wild mammals and birds raised in captivity, and to capture wild mammals and birds for propagation.

Ontario: Minister of game and fisheries may authorize persons to possess, buy, sell, and export game animals and birds raised in captivity, and to capture game animals and birds for propagation during close season. Imported game may be sold or exported under license.

Prince Edward Island: Domesticated wild geese and brant in captivity are deemed personal property of owner, and may be possessed, disposed of, and transported without reference to the provisions of the provincial game act. Waterfowl and other migratory birds, however, are subject to the provisions of the migratory birds convention act and regulations.[18]

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[17] See Federal regulation 8 for full details and requirements (footnote 3, p. 7).

[18] See Canadian regulation 13 (footnote 3, p. 7).

Quebec: Minister may authorize game animals and birds lawfully taken during the open season to be retained in captivity.

Saskatchewan: Minister of railways, labor and industries may authorize persons to possess, buy, sell, and export big game and game birds raised in captivity, and to capture big game and game birds for propagation. All shipments must be tagged. Permit and tag fees fixed by minister.

Yukon: Gold commissioner may authorize persons to possess, buy, sell, and export game animals (except buffalo or bison) and birds raised in captivity, and to capture such animals and birds for propagation.

Newfoundland: Game and inland fisheries board may authorize persons to capture, possess, buy, sell, and export caribou for propagation.

FIELD SERVICE, DIVISION OF GAME AND BIRD CONSERVATION, BUREAU OF BIOLOGICAL SURVEY

[Violations of Federal game laws may be reported to the nearest official listed, or to the Chief, Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C.]

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William H. Hoffman, box 1022, Mobile, Ala.
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W. T. Cox, Superintendent, Upper Mississippi River Wild Life and Fish Refuge, Winona, Minn.

David H. Madsen, Superintendent, Bear River Migratory-Bird Refuge, 321 State Capitol, Salt Lake City, Utah.

UNITED STATES RESERVATION PROTECTORS

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L. L. Bryan, Big Lake Bird Reservation, Hornersville, Mo.
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